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☞ An asterisk (*) denotes an illustrated article

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WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

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A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

The *Journal of Gas-Lighting*, of London, is about to issue in monthly parts, this valuable treatise which has been appearing in its columns for some time past. It will be one of the most valuable compendiums of informatinn on the past and present practice of the Science that has ever appeared. It will be liberally illustrated with plates and cuts, some of which alone will be well worth the price of the numbers containing them. We recommend every coal gas maker to subscribe for it. Subscriptions may be sent to this office, and the copies will be furnished as soon as they are ready. Full particulars as to price, &c., will be given as soon as possible. Each number will contain from 28 to 32 pages; and the pages are about 10×12 inches. They will be issued in paper covers, and can be bound to suit individual taste after all are received.

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REPORT OF THE GAS COMMISSIONERS OF THE CITY OF BOSTON.

The Commission, consisting of Chas. F. Choate and John Felt Osgood, Esqrs., and Professor Edward S. Wood, of Harvard University, was appointed, early in the year 1875, to investigate and report—

"(1) Upon the quality and price of the gas furnished in this city as compared with other large cities in this country and Europe; (2) whether any improvements can be made in the present methods of manufacturing gas by the different companies in this city; (3) whether it would be expedient for the city to undertake the manufacture and supply of gas for public and private lighting; and (4) whether any further legislation is desirable to enable gas consumers, or the municipal authorities, to secure a prompt and impartial investigation of complaints against private companies, and an efficient remedy for any abuses of which they may be found guilty."

To this duty they have carefully attended by examining the processes used in the manufacture of illuminating gas; by a comparison of several gas companies and works; by considering the relations of gas companies to municipal corporations, and by examining the effects of competition. The conclusions at which they arrive are of interest, not only to the gas companies of Massachusetts, but also to those in other states. The text of their report has been furnished mainly from an inspection of the acts and doings of the Boston Gas-Light Company, a corporation which has already contributed largely to the proper understanding of their rights and duties as manufacturers and sole suppliers of their merchandise to their districts, in printed documents familiar to gas engineers. Returns were, however, made by ten Massachusetts companies which are tabulated in the report. Of these ten companies, six of the seven companies supplying Boston, with a capital of $4,613,000, made in the year 1875, 940,338,000 cu. ft., of an average value of over 17 candles, according to the tables, which also contain similar figures for six other New England companies, five other American companies, and twelve foreign companies. In addition there are such other items of inquiry as were contained in the circular sent to the different gas companies, with such answers as the commissioners were authorized to print. The commissioners state that in course of their investigations they visited the gas works in New York, Brooklyn, Philadelphia, Chicago, Detroit, Saratoga, Poughkeepsie, Boston, and vicinity, Lowell, Lynn, and New London, and have satisfied themselves of the quality of gas supplied in those cities and other places, in regard to illuminating power and deleterious impurities. Of this laborious investigation their report of 94 octavo pages gives the results.

The important part of their report consists in the conclusions at which they arrive.

Their first conclusion is—

"That the citizens of Boston are being supplied by the Boston Gas-Light Company with gas of excellent quality, and at a price, in comparison with the cost of coal and the quality of the gas, lower than in most of the cities of the United States."

On this we make no comments, as the facts were generally known to the profession before.

Their second conclusion is—

"That there are other processes than those in use in the various companies in this city by which illuminating gas can be made, and for which great improvements in regard to cost and quality are claimed; but none of these, with one exception, have yet been tried for a sufficiently long time and upon a sufficiently large scale to warrant an unqualified recommendation. That exception is the substitution of naphtha or petroleum in the place of enriching coal. By this means we consider that great saving may be made, providing that the price of naphtha does not much exceed 10 cents per gallon delivered at the works, and the advisability of employing this substance in the manufacture of gas depends entirely upon the probability or certainty that the price shall not exceed materially this figure. At this present time, however, it would probably be impossible for a large gas company like the Boston Gas-Light Company, to make use of any process for the manufacture of illuminating gas from naphtha

or petroleum, without either paying a considerable royalty or becoming involved in lawsuits for the alleged infringement of some patent. It is, nevertheless, doubtful whether any of the patents for using petroleum or naphtha in gas-making are valid."

This conclusion indicates that the commission differ, as they elsewhere state, from the great body of engineers as to the danger of the use and storage, in a large way, of naphtha and other explosive materials for the manufacture of gas.

Their third conclusion is—

"In regard to the other subjects included in the order quoted at the beginning of this report, we recommend that virtually the same measures should be adopted, which have been found by long and careful consideration of the relation of gas companies to the public to be best in reference to the London gas companies, viz., the fullest publicity in relation to their entire business. In order to accomplish this result, we would advise the City of Boston to petition to the Legislature of Massuchusetts for the appointment of a permanent board of commissioners, similar to the railroad commissioners, who shall have authority to thoroughly inspect the gas of all the companies in the State, and also through a competent auditor to examine the accounts of the companies. These accounts should be published annually, so as to ensure publicity, and should be kept according to some definite plan.

* * * * * * * *

"The commissioners should have the power to recommend the price of gas in all the cities and towns in the Commonwealth, at such rates as would allow the earning of a dividend of not more than ten per cent. on the capital, and any excess of profit should go toward ensuring a diminution of the price the following year. This commission should be the tribunal authorized to investigate all complaints between consumers and the corporation, and the establishment of such a commission would probably result in bringing about such changes in legislation in regard to its powers and duties as actual experience would show to be necessary and judicious.

"In London it was found impossible to induce the gas companies to consent to all the regulations of Parliament, until a strong effort was made to obtain permission for the municipal government to erect gas works and sell gas to the citizens, when the gas companies were obliged to accede to all of the propositions for fear of the unequal competition of the government. Although we do not deem it necessary to resort to the same expedient, yet the same difficulty *can* arise in the case of any company whose charter was granted previous to March 11th, 1831, at which time an act was passed rendering all charters granted after that date subject to alteration by the Legislature. We, therefore, recommend, that the City of Boston petition the Legislature for an act permitting the city to erect gas works, and manufacture and sell gas to its inhabitants: and should it happen that the Boston Gas-Light Company, or any other, whose charter is dated previous to 1831, if there be any such, will not comply with such reasonable regulations as may be deemed nesessary to ensure publicity in regard to their business, proper inspection of their gas, and a limitation of their earnings, we would recommend that the City of Boston itself, providing that the right can be obtained from the Legislature, erect works (or purchase those already erected within its limits) and manufacture gas for the supply of its citizens. The gas supply can be managed in about the same manner as the water supply, which, it cannot be denied, has in past years been very successfully carried on.

"We advise most decidedly against the admission of another private gas corporation within the limits of Boston to compete in the sale of gas with the existing companies, as being disadvantageous to the public generally.

"In the performance of such business as the sale of gas or water, which must be a monopoly, in which the public cannot have the benefits of competition, we consider it beneficial to the public interest, that the system of discounts to large consumers should be abolished."

The first clause in this conclusion recommends specifically the appointment of a permanent board of gas commissioners, who shall prescribe annual reports from every gas company in the State, on some definite plan, similar to that prescribed by the London Board of Trade, who shall also exercise a supervision over the quality and price of gas sold. Theoretically, there is no objection to this plan; but, practically, there would be great difficulty in carrying it out. The board, itself, should consist of at least three individuals; and if constant inspection of the grade and quality of gas throughout the whole State of Massachusetts is designed, at least two or three inspectors familiar with the process and results of gas manufacture must permanently be supported. From the nature of the business transacted by each gas company, and the many processes in use, with differing and distinct results, no ordinary skill would be required to detect differences and properly weigh values.

The clause recommending the City of Boston, under certain contingencies, to apply for the right to manufacture gas, furnishes no panacea for the curing of such evils as they dread. They certainly possessed, by previous hearings before the city government, and by the statements of their own report, very minute information as to the acts and doings of the Boston Gas-Light Company. They also have partial returns from most of the other companies supplying Boston. Returns similar to those made by the London companies afford valuable results, in the *comparison* of the operations of *large* corporations; but when such returns are to be required of little companies, struggling to sustain themselves in small towns scattered throughout the State, comparison between their results and those of the Boston companies would have little value or interest to the public generally, and few, except practical experts, would be able to draw correct conclusions from facts obtained under such widely differing conditions.

So far as the Boston Company is concerned we do not understand, from the report, that they have not met every question put by the commission fairly and squarely. But one can readily understand why they should have some delicacy in allowing their answers to be printed; if the large companies outside of Massachusetts, with which alone a just comparison can be made decline to furnish the same facts. Looking from our point of view, it appears to us that the threat of a municipal charter was entirely unnecessary, as the citizens of Boston have no more to fear from the Boston Gas-Light Company in the future than in the past. What guaranty the municipality would offer to its consumers, in relation to the quality and purity of their gas, does not appear. What satisfaction a complaining customer would obtain from a city official we need not state. We have no personal knowledge how the water works of Boston are conducted; but it must be borne in mind that the supply of water does not involve any manufacture of the article furnished, while the supply of gas does involve a manufacture whose different processes demand the application of the most subtle of sciences, and the skillful guidance of trained minds.

We do not believe that a city should undertake the manufacture of gas any more than it should establish bakeries, or manufactories of oil, kerosene, or candles, or any other necessity of life.

The next clause will not be disputed by any person having practical knowledge of the inconveniences, as well as the increased expense, arising from competing companies in the same street. It would have been fortunate for other cities if this question had been as well settled in them as it has been in Boston.

With regard to the final clause recommending that no discounts should be allowed, and that the whole manufacture of a gas company should be delivered to every consumer, whether small or large, to public or private lights, to the citizen and to the municipality, at the same horizontal price, we do not believe that any gas company would object, provided the price settled on would make a fair return on the capital invested.

The conclusions of the report have been noticed; but we have not the space to go into voluminous details on which these results were grounded. Every gas engineer will read them with the attention and consideration which the highly respectable character of the commission deserves. The task which they had set before them was one of great difficulty. They have shown sagacity and courage. Such scientific and economic results as are given may require our further examination.

SPONTANEOUS COMBUSTION IN COAL.

At this season it is advisable to test the temperature of all piles of coal, whether in sheds or out of doors, in order to detect any tendency to heating. The usual method of running down tubes (ordinary inch pipes, sharpened at lower end) from the top of the piles to the bottom, at frequent intervals, will repay for the trouble. Whether in sheds, or out of doors, coal is apt to heat, and more particularly so after being stored about three months. In many places tubes are always kept in the piles, and the temperature taken daily, by lowering a thermometer into them; in this way any accumulation of heat can be easily detected, and the remedy applied before loss is incurred.

When undue heat is detected turning over that portion of the pile is the surest remedy. In several cases of heating that have occurred in this vicinity recently, only the watchfulness and promptness of those in charge have prevented serious losses.

Metric System.

In a memorial of the "International Association for obtaining a uniform decimal system of Measures, Weights and coins," presented to Honorable Benjamin Disraeli, Chancellor of Her Majesty's Exchequer, in March. 1859, it is estimated that the adoption of the Metric System would save in the management of the London and Northwestern Railroad £10,000 ($50,000) a year s and in the various departments of her Majesty'; Government not less than £500,000 ($2,500,000(every year.

When we consider that this computation was made by competent authorities, and remember that the amount named would be saved *every year* by a single railroad, it is evident that the total saving made by the adoption of the Metric weights and measures would be almost incredibly large. The same proportionate saving would be effected in every market, store, factory, counting-room, in short everywhere, for in business life nearly every sentence spoken or written contains some expression of quantity.

Fourth Annual Meeting of the American Gas-Light Association.

NEW YORK, OCTOBER 18, 1876

At the conclusion of the reading of Mr. Cathels's paper the President announced the names of the committee to nominate officers,

The Association then took a recess until two P. M.

AFTERNOON SESSION.

The Association met at two P. M., pursuant to adjournment.

Upon request of the secretary, Mr. Cathels explained at length the details and principles of his gas washer, a model of which was placed on the stage in view of the members, as were also a series of drawings representing retort settings.

The Secretary—Please explain to the Association some of the characteristics of your retort settings.

Mr. Cathels—The only difference between these and the ordinary method is that, in one case, as I have already described in speaking of the apparatus before you, it is longitudinal or running heat, and in the other it is vertical heat. The heat plays all around the retorts at right angles to them. The drawings are too small to be easily understood, but the chief characteristic is that the retorts are divided into two or three lengths. In the case of the two chambers the heat plays around the retorts and, striking against the retorts, passes through the openings of the cross-wall, and descends among the retorts between the division wall and the oven. The division wall is usually made nine inches thick. It requires very large drawings to illustrate the plan thoroughly.

The Secretary—What proportion of coke, on the average, is necessary for your best setting?

Mr. Cathels—I can only answer that by taking the experience of a half a dozen successive years, during which time I have used these settings, with seven retorts of 21″ by 15″ internal diameter, each charge taking a ton of coal. That is what I used at Sydenham, England. At Montreal we have the same setting, and the consumption of coke fuel is just about identical. The Nova Scotia coke is not quite as good as the Newcastle coke, but it requires very little more. With these settings we sold 87 per cent. of the coke. In reckoning the result I have calculated, not upon bushels, but upon the English method of calculating by chaldrons. Assuming that a ton of coal produces a chaldron of coke, and that we carbonized 100 tons of coal, the percentage of coke would be about 13 per cent., and, as I have stated, we have sold 87 per cent. of the coke from the 100 tons that we carbonized. Putting it in bushels—it takes eight sacks, of three bushels to a sack. That would be twenty-four bushels of coke for twelve hours, and 16 sacks for twenty-four hours.

The Secretary—How many retorts have you!

Mr. Cathels—We have seven.

The Secretary—You made your estimate of 24 bushels of coke for seven retorts at 12 hours?

Mr. Cathels—Yes.

Mr. Cartwright—Why base it upon 12 hours? Why not reduce it to 48 hours?

Mr. Cathels—I take 12 hours because we put one gang of men against another, for that length of time, to see which gang does the most. One foreman works a gang duriug the day and another during the night, and we compare the amount done by one gang with that done by another.

A member—How much yield of gas do you get out of a retort on a twelve hours' charge?

Mr. Cathels—We get 5,000 feet on an average. It ought to explain that we have stored these coals. We cannot make as much gas out of a coal that we have had on hand for some time as we can get from freshly-mined coals. I suppose we could get from coals fresh from the mine, probably 9,500 feet. These coals upon which I have made my estimate were stored. We could make, with fresh-mined coals, perhaps a few thousand feet more. We don't get more than 5,000 or 5,500 feet, perhaps, on an average.

The Secretary—That is in a twelve-hour charge?

Mr. Cathels—Yes.

The Secretary—What yield do you get per pound?

Mr. Cathels—I cannot say positively as to that. I have not figured it upon that basis. We get about 9,500 per ton on coals that are fresh-mined. I never had an opportunity of using either Penn or Youghiogheny coals. I cannot say what would be the yield from these coals, nor have I figured what the yield would be from Nova Scotia, or Lower Province coal, per pound.

The President—Do you mean a ton of 2240 pounds?

Mr. Cathels—Yes; a long ton.

The President—You can get, with Lower Province coal, out of a ton of 2240 pounds, 9,500 feet?

Mr. Cathels—Yes.

Mr. Cartwright—I notice, in the reading of your paper. an allusion to works that had been constructed upon some plan or other that entirely failed in the course of three months. Can you tell us whether it was owing to a defective plan of the settings, or to the material of which they were composed, or was it owing to the foundation of the benches?

Mr. Cathels—I ought to explain to the Association that I did not see the retorts myself; but I heard an account of them from one who saw them and knew about them. Mr. Littlehales can give you more information upon that point perhaps than I am able to do.

Mr. Cartwright—Mr. Littlehales, did you see the retorts before they were put in?

Mr. Littlehales—I saw them when they were set. My own opinion is that they gave way simply for the reason that they were not properly supported. We all know that if retorts are put up, and are not sufficiently studded, though the retorts may be very good, they will not stand. If the retorts are not made sufficiently strong when they are put up they will come down.

Mr. Cartwright—I got the impression, from the reading of the paper by Mr. Cathels, that the defect was in the plan, whatever it was, and I only wanted to know whether the defect was in the plan or whether it was in the manner of setting the retorts.

Mr. Littlehales—The retorts were not properly studded.

Mr. Cartwright—We all know that retorts, if not properly set, will not stand. I, myself, have seen retorts which were put up and which came down in two or three months. But it was owing to the fact that they were insecurely supported; but it was not owing to any defect of the plan upon which they were set, and I asked the question of Mr. Cathels for the purpose of gaining information upon that point. I supposed that he spoke from what he had actually seen, and from facts which had come within his observation, rather than from information which he had received from other parties

Mr. Cathels—In reply to Mr. Cartwright, I will say that I have been the manager of gas works for 25 years, in this country and in England, and I say, from my own experience that it must be owing to some defect in putting up the retorts if they come down in three months. There is often very great mismanagement in the setting of retorts. It is a very frequent occurrence that retorts are put in and remain for many years, and, on the other hand, it sometimes happens that retorts are put in and only stand for a few months, which is owing, in my opinion, to the fact that they have not been properly put up. There must be something radically wrong in the setting of the retorts, if they come down so soon. Sometimes if a retort has been put up for six months, cracks will appear in it. For my part I do not care about cracks in a retort. The principal thing in setting them up is to be careful that they are securely supported. If that is the case, the appearance of cracks makes but little difference. In my own opinion it has frequently happened that cracks have made their appearance in the retorts, but after a couple of charges or so they would be as tight as ever.

Mr. Cartwright—Do you know whether the fault in the retorts, of which you have spoken, was owing to some defect or neglect in the management of the stokers?

Mr. Cathels—There is very frequently some mismanagement in that respect also.

Mr. Cartwright—I have seen trouble arise in this way in my own experience; and, in putting the question to Mr. Cathels, I was anxious to get at the fact whether the defect in the retorts, of which he spoke, was owing to a defective plan, or to mismanagement on the part of the stokers or defect in the material employed.

The Secretary—I would like to ask Mr. Cathels whether there are any retorts, to his knowledge, set after his most approved setting, in the States?

Mr. Cathels—I am not prepared to answer that. I have supplied tracings of some of these settings to one or two gas companies in different places; but I never have had, since that time, any communication from them in regard to it, and, therefore, I am unable to answer the question.

The Secretary—I would like to know what success the parties met with to whom you furnished the drawings, and the kind of coal that was used?

Mr. Cathels—I cannot answer that, sir.

Mr. Wood (New Bedford)—I will say that in New Bedford we have some retorts put up after the manner of Mr. Cathels's plan of setting—though I cannot say that they are put up according to his best plan, as he has described it. Our benches are small ones, six feet and eight inches inside in width. Consequently, the retorts are small. But we are now using three benches of these retorts, with 160 pounds to a charge, which is all our consumption calls for. Our benches not being quite large enough, we are using them with 84 bushels of coke for 24 hours, and saving from 170 to 190 bushels a day, with a charge of 160 pounds. You can figure it for yourselves. You may say that it is a very small charge, and it is. Our retorts are only made to carry 180 pounds.

A member—You have not stated what coal you use.

Mr. Wood—We are using Penn coal, with a little Newburgh Orrel. We use that because we find that we can make better gas with two kinds of coal, one an inferior kind mixed with a higher grade. That is our experience at our works.

Mr. Gerould (Newton. Mass.)—What is the size of your retorts?

Mr. Wood—The retorts, as I said, are rather small. The old sizes are 12″ and 20″ by 8 feet long; the better ones are 14″ by 22″, and six feet in the base.

Mr. Gerould—How much gas is produced in 24 hours.

Mr. Wood—That depends entirely upon the amount of coal we put in. I would state that in small works like ours, we cannot run our retorts to their full capacity. There is a great jump from two benches of threes to two of sixes.

Mr. Gerould—I ask for the best you can do.

Mr. Wood—4·70 feet to the pound we made during the eight months this year. Our average has been 4·94 to the pound in other months, but our yearly average will be about 4·70.

Mr. Cartwright—What is the illuminating power of the gas?

Mr. Wood—The minimum is seventeen candles, and the maximum about twenty.

Mr. Gerould—How much do you sell?

Mr. Wood—I will state that our loss has been between 11 and 12 per cent. per annum, our yearly loss. It was greater last year. This year it will be about 10. We are making about 80,000 feet per day.

Mr. Cartwright—Do I understand you to say that you produce on an average 80,000 feet per day, at 4·70 to the pound, with Penn coal and Orrel?

Mr. Wood—Yes. Our experience is that Penn coal and Orrel make as clear a gas as Penn coal makes alone, in our works, and a brighter gas.

A member—What photometer do you use?

Mr. Wood—We use Bunsen's photometer.

Mr. Cartwright—And you say you can make at 4·70 to the ton, an average of eighteen candles?

Mr. Wood—We can make about that average. As I said our minimum is seventeen candles, and our maximum is about twenty, and our average is about 4·70 to the pound.

The Secretary—I will state to the Association, before we dismiss the subject, that Mr. Cathels will be pleased to give any explanation of the apparatus before us, and of his drawings of retort settings, to any member of the Association who may desire to make inquiries about them; and he will, tomorrow morning, explain his apparatus, its mode of operation, and its capacities and its merits.

The President—Is the finance committee ready to report?

Mr. Harbison—I am instructed by the finance committee, to whom the Treasurer's report was submitted, to say, on behalf of that committee, that I have examined the entries of the Treasurer, of both receipts and payments, and find them to be correct.

On motion, the report of the finance committee was accepted.

The Treasurer then read his report as follows:

So far as the cash of the Association is concerned, I have to report that I had on hand at the commencement of the fiscal year—

Cash	170.11
Received for Initiation fees	330.00
" " Dues	570.00
One copy of the Proceedings sold	1.40
Total	1071.51
Paid out for sundries	84.54
Rent of hall in which last meeting was held	100.00
Parlor	21.00
Salary of Treasurer, 1875	250.00
" " " 1876	250 00
	705.54

Leaving a balance now in Treasury of $365 97. That is as it stood at the close of the 17th. I have received about $30 of annual dues for the current year, not embraced in this sum. We had 161 or 162 active paying members, prior to the initiation of the members at this meeting. Any one can see at once that the annual income from them is about 805 or 810 dollars. There are thirty four names on the roll whose dues are unpaid for the last year. Some two or three of these are duplicate names which I found on the record, and I have never found any means of correcting it accurately. Some 22 or 23 of the others I deem to be perfectly good. The money will be paid. It is possible that some of the others may pay, and I believe they will. At any rate the annual dues of the 22 make $110, which is to be added to the annual dues of the current year. Mr. Neal tells me that 16 have been admitted to-day. Of course the initiation fee is $10 for each, and this is to be added to the balance now on hand. There are some few of the dues which are unpaid that are doubtful; but it is probable that they will be paid before the next meeting. So far, as to the money.

As to the standing of the Association—aside from that—I may say that we are furnished regularly with a copy of the American Gas-Light Journal, as a gift to the Association. We are also furnished with a copy of *Saward's Coal Trade Journal*, also with a copy of the *Manufacturer and Builder*, from Pittsburgh. These papers are bound in volumes, and preserved as part of a library. As I stated before, I have received some fifteen volumes from Monsieur Durand, of Paris, works which he has written on various gas topics. They are written in French; not being a French scholar I am unable to give you an idea of their contents. That, I believe, is about the situation of the Association.

I shall be happy to answer any questions which any member of the Association may propound, and give any information in regard to the finances of the Association which may be desired.

A member—I did not understand what the balance was on hand.

The Treasurer—$365.97. I am not aware that we owe a single dollar.

Mr. Harbison—I would suggest that the Treasurer read again, for the benefit of such members of the Association as have just come in, the synopsis that was previously read.

The Treasurer again read synopsis of the report, and said—

I would state that, at the meeting last year, the salary of the Treasurer had not been paid for the year before, so that, in fact, we owed $80. This year we are entirely free from debt, with this balance in the treasury. Now, there is one other matter that I would like to speak of, in connection with the business of the Association, which comes in as a part of the Treasurer's Report. Last year the Association directed the secretary to have printed the 500 copies of the proceedings of the meeting, and of the one held in May, at Washington. At an expense not to exceed $250. There proved to be much more matter than was expected. I got an estimate, not from one but from two of our most substantial printers, and the least that I could get the proceedings printed for was $325; so that our proceedings for last year have not been printed, for that reason, and the money is in the treasury unappropriated. If the Association should see fit to order them printed, together with the proceedings of this meeting, in one volume, we have the money to do it, and also to pay current expenses. The proceedings in Washington would have been printed, together with the proceedings of the October meeting, but the Association limited the price; and, as I have stated, the matter was more than could be printed for the money.

Mr. Harbison—I must ask the secretary if he made any efforts to have the printing done, or to get any estimates of its cost outside of the city of New York?

The Secretary—I did not.

Mr. Harbison—It may be true that he was unable to get the printing done at New York prices, but it is more than likely that he could get it done at some town outside of New York for much less money.

The Secretary—I am obliged to the gentleman for the information; and if I have any occasion to make use of it I shall certainly do so. I don't want to spend any more money than is absolutely necessary.

A member—What do you pay for the rent of this room?

The Secretary—Fifty dollars a day.

A member—It strikes me, Mr. President, that a much smaller room than this would answer our purpose quite as well, if not better. Fifty dollars a day for the rent of a room of this size is a very considerable sum of money. It does not seem to me that the members of the Association require so large a room.

The Secretary—I would say, in reply to the gentleman, that I made very thorough inquiry to find a smaller room, and at the same time, one which would answer our purpose, and I was unable to find one which I thought would be suitable for the occasion. We could find longer rooms, and at the same time large, but we did not think they would be suitable, and we thought we had procured a room that was very reasonable. At the second meeting of the Association we paid the same amount of money. We paid $100 last year. In Brooklyn we paid $50, if I recollect right, but that was more in the nature of a gift, and was so stated by Mr. Howe, who was connected with the Brooklyn Company, and made the arrangement. He stated that it was more in the nature of a gift; that it was a mere nominal rent, and at Willard's Hotel in Washidgton, the rooms in which the meeting was held were connected with the hotel, and as the members made that their headquarters, that was a consideration, and we paid only $50 for the room.

Mr. Neal—I hope a smaller room will be procur if possible, next year. I think that when the meetings are held in a smaller room they are much more pleasant and much more social in their nature. When the New England Association first met we took a large room, but we found afterwards that a small room would be much more agreeable, and we took a parlor in the Tremont House. I think that it adds to the enjoyment and the pleasure of the meeting to have a room where every one can hear what is said, and where the members can feel more of a social feeling than they do in a room which is so large. New York is a great place. I don't mean at present, but I mean when we are away. (Laughter.) I don't mean my remarks to apply to the room for this meeting, but I hope the suggestion will be found to be a good one in regard to our future meetings. If we cannot get a room suitable for our purpose at a more reasonable price, it is an additional reason why we should have a room where we can all get together in a social way, and discuss the matters which may come before us, and I hope this suggestion will meet with the favor of the Association, and will be carried out by those who have charge of looking for rooms for subsequent meetings.

Mr. Allen—I would like to inquire whether the Gas-Light Journal does not voluntarily publish very fully the proceedings of our Association. I am informed that it does, and I presume that all the members have that Journal, or at least they ought to have it; and I would like to know if it is not unnecessary, in addition to that, to spend $50, or $200, or perhaps $300, to publish the proceedings. It does not seem to me that the income of the Association will warrant so much publication. I do not think it is necessrry for us to spend so much money in this way, inasmuch as we have the Journal containg the full report, in our hands. Of course the previous publications have been made under the direction of the Association, and those directions have been faithfully discharged by the secretary, and the expense incurred ought to be paid, and I only make the inquiry as to future expenses. I move that the treasurer's report be adopted.

The motion was put and carried.

The President—There was another matter that was laid over until the report of the secretary should be read, and that was in regard to the salary of the secretary being $350.

On motion, the recommendation of the Executive Committee in regard to the salary of the treasurer was adopted.

The committee appointed to select the names of the officers for the ensuing year, then reported as follows:

President—Gen. Charles Roome.

Vice President—W. H. Price, Cleveland; George B. Neal, Mass.; T. Littlehales, Canada.

Secretary and Treasurer—Charles Nettleton, New York.

Finance Commiitee—John S. Chambers, Trenton:

J. P. Harbison, Hartford; George McIlhenny, Washington.

Executive Committee—W. H. Denniston, Pittsburgh; George D. Cabot, Mass.; A. Hickenlooper, Cincinnati; Henry Cartwright, Philadelphia; Wm. H. White, Brooklyn; Henry Stacey, Indianapolis.

On motion the report was adopted.

On motion of Mr. Wood of Syracuse, the secretary was authorized to cast a ballot on behalf of the Association for the officers proposed.

The secretary then preceeded to cast the ballot as directed by the Association, in favor of the officers named by the committee, and declared them to be duly elected.

The President—Gentlemen of the Association: As one of the officers nominated by the committee and elected by the Association, I desire to return you my thanks for the confidence you have shown in me, and for the honor which you have conferred upon me. I had hoped that a successor would be found to assume the duties of this office. It is not, as you are aware, a very arduous position, but it has been your pleasure to confer it upon me for several successive years and I am willing to see it pass into other hands. However, as you have manifested a different disposition, I bow to your will. (Applause.) I understand that Mr. Sherman of New Haven was to have prepared a paper on "Naphthaline." If he is here I trust he will come forward.

Mr. Sherman—Our worthy and enthusiastic secretary, without any consultation with me, and upon a conditional promise, has put me down for a paper on "Naphthaline." I have not, for reasons which I will presently give you, prepared any paper on the subject. In my own experience I have used various devices for getting rid of naphthaline. I have suspended mains around the retort house walls. I have had Graham's Coil Condenser, and have used the expedient of putting naphtha in the purifiers, and in the drips, but with no great success. The New Haven Gas Company, from plans and specifications of William Farmer, erected what is called a tar scrubber, and their experience justifies, so far, all the expectations which were raised in regard to that apparatus. I had intended to present a paper describing this apparatus, but Mr. Farmer has very kindly furnished me a description of it, which is so much better than anything I could give, that I propose to have his paper read *verbatim;* and owing to a defective vision I will ask Capt. Dresser to read the paper for me.

SMITH & FARMER'S CONDENSER AND SCRUBBER.

Gentlemen: Though the majority of gas engineers have, for some time, been fully convinced that the gas and tar should be kept well in contact for a certain time immediately after they leave the hydraulic main, no efficient apparatus has yet been introduced that has thoroughly answered the purpose.

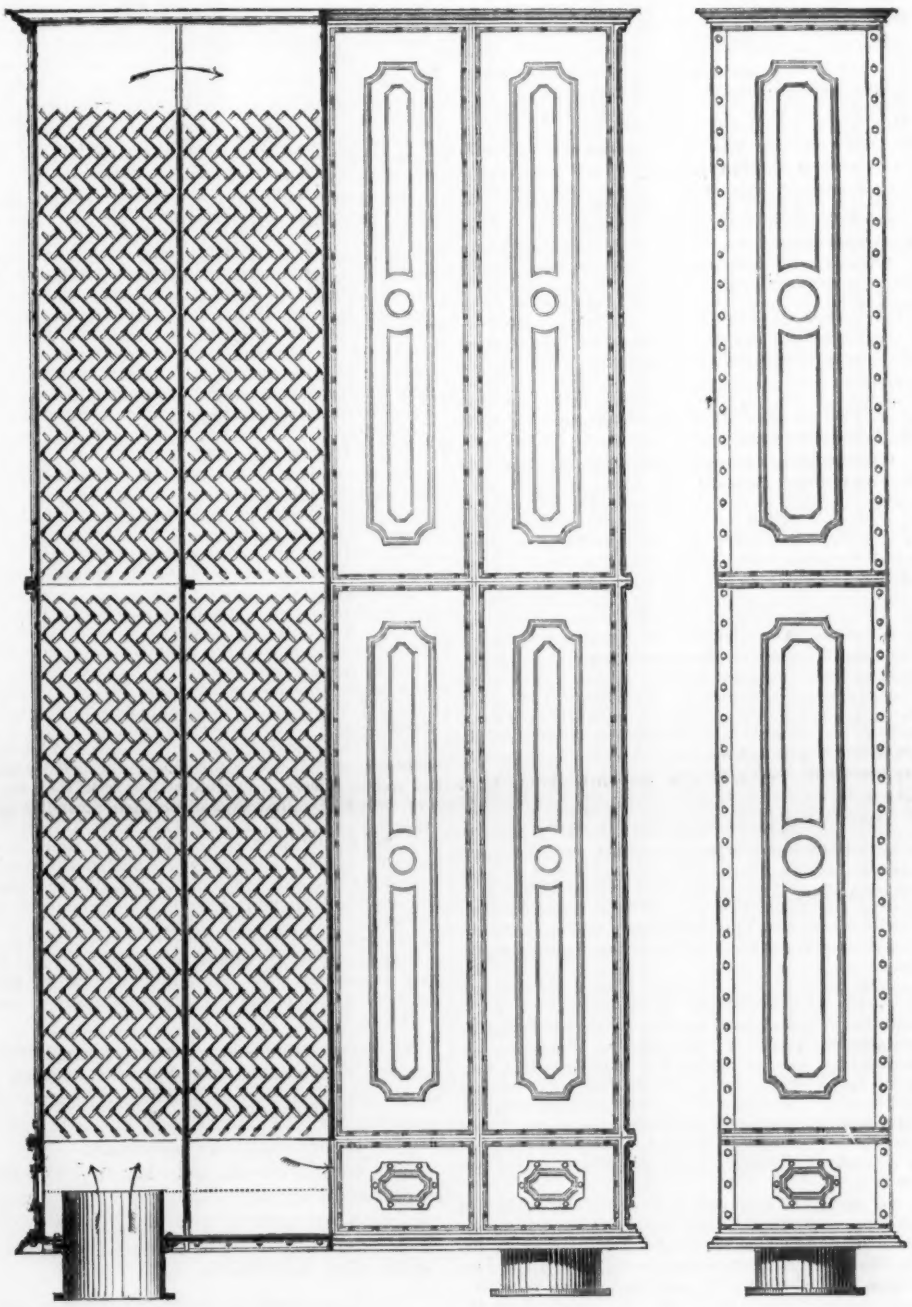
Some engineers carry the gas two or three times round the retort house walls in mains, which are hung on the walls of the house; but it is easily seen that this system is a very round about one for carrying out the idea, for the gas is not kept thoroughly in contact with the tar. The gas deposits the tar on the bottom of these mains, and the gas merely passes over it; hence the tar and ammoniacal liquor are not thoroughly utilized before they escape to the tar well.

When the hot gas, tar, and ammoniacal liquor are kept well in contact we find that it enriches the gas and removes a considerable portion of the carbonic acid and sulphuretted hydrogen from the gas; and it also prevents the deposit of naphthaline in the mains and services.

I will now introduce to your notice a very simple and efficient apparatus, which has been found to answer the purpose admirably.

This apparatus can be made with one or more shafts, and of any area and height to suit the capacity of the works.

Each shaft is filled in with diagonal plates, each about six inches, and placed about two inches apart. The said plates are all supported on lugs or projections which are cast on the side plates, and all the diagonal plates are so set that the hot liquor which is deposited on the plates by the gas, must fall from one plate to the other in its passage down the shafts, and consequently must make a series of drips through which the gas must pass, with a zig-zag motion, in its passage through the apparatus.



In the apparatus shown in the drawing there are four shafts or compartments, and fifty series of drips in each of the shafts.

This arrangement keeps the hot liquor much longer in action than any other, consequently it must be much more efficient.

This apparatus should always be erected in a warm building, and as near to the hydraulic main as possible.

From this apparatus the gas should next pass on to the ordinary multitubular condenser, to be reduced to the proper temperature before it enters into the water scrubbers.

To strengthen my statements I will now give a few important extracts from the *Journal of Gas-Lighting*, and also from W. R. Bowditch's book on "Analysis and Use of Coal Gas."

"It may, perhaps, excite a little surprise when upon examining into the nature and production of coal tar, we come to treat of it first as a purifying agent. Nevertheless such it really is; and without this or some similarly constituted substance, there can be no doubt in the world that the purification of coal gas would be almost an utter impossibility. * * * * * * *

"Hence we find that tar consists not only of several compounds of a fluid kind as usually represented, but contains also a large proportion of solid carbon or soot, which soot or carbon has been removed from mechanical admixture with the gas, by the peculiar attractive and condensing power of the various hydrocarbon compounds.

"As it is well known that soot has a great affinity for hydrocarbon vapors, it is unnecessary to say that they must also have a like affinity for soot, and therefore the minute and almost atomically divided particles of carbon which arise during the destructive distillation of coal, being in immediate contact with hydrocarbon matter, combine with and are condensed with this vapor into the black viscid fluid called tar. Nor would it, as we have said, be possible to separate this carbon from the gas, unless some such an arrangement existed as that by which the tarry vapors and the carbonaceous particles are first brought into mechanical admixture, and subsequently condensed together into one fluid.

"If, therefore, it were possible to make gas without the production of condensible hydrocarbon compounds, the subsequent difficulty caused by the accumulation of carbonacious particles, would oppose an insurmountable barrier to success. * * * * * * * This soot has no affinity for water or watery vapor, which indeed repels it, consequently steam is of no use in effecting its condensation; and it is so min-

utely divided and so little ponderous, that the mere current of the gas is sufficient, by its motion, to carry it occasionally even into the street mains.

"Naphtha, turpentine, and electro negative vapors generally are the only agents capable of combing with it; electro positive vapors as that of water repel it, and this brings us back to our previons assertion, that coal tar, or rather the hydrocarbon compounds contained in coal tar, exercise an important and indispensable function towards the purification of gas.—LEWIS THOMPSON, *Journal of Gas-Lighting.*"

"Hitherto, *principles of science* seem to have had but little connection with condensation; but if the gas has been reduced to the 'proper temperature' before it passed into the scrubbers and purifiers, the true object of purification has generally been considered as accomplished. An engineer has thus expressed the general aim and opinion: 'Still further to separate all condensable vapors before allowing the gas to pass to the purifiers, a set of condensers in coolers is provided, through which the gas is made to circulate until it is reduced to a temperature bearing some approximation to the surrounding atmosphere.'

"There could be no more mistaken practice than the one commonly adopted, for it is in the power of most engineers to make a considerable difference in the illuminating power of all the gas they manufacture. by the adoption of a better mode of condensation. The increased illuminating power obtained by a superior method of condensation, is obtained almost without cost for materials, whereas, when gas is improved by the use of Cannel coal, the cost for material is considerable. * * * * * * * * * * *

"So few people are conversant with the principles involved in this question, that I propose to consider some of its details, in order to make the matter clear. The proper object of condensation is the removal from gas of substances produced in the distillation, which for some reason are not useful for this purpose of illumination, and the retention in the gas of all the substances which are useful as illuminants, and can be distributed with the gas. The heaviest hydrocarbons are useful as illuminants but cannot be distributed with the gas, and therefore they should be removed. But the gases and the lighter hydrocarbon vapors are useful and can be distributed, and therefore no more of these should be removed than is absolutely necessary to effect a proper removal of the compounds which must be removed, because they are useless as light-givers or cannot be distributed. Of all the substances the most useful as light-givers, when burnt with gas, are the vapors of hydrocarbons, and therefore every pains should be taken to keep in the gas the largest possible quantity of these vapors. All the light hydrocarbons known as 'coal naphtha' have been obtained by the distillation of gas tar, and consequently have been separated from gas by the process of condensation now used in our gas works. If gas be passed over this naphtha it gradually disappears, and the gas which passes over the naphtha acquires considerable greater illuminating power than it possessed before its passage over the naphtha. This simple experiment shows first, the illuminating power of the naphtha which was removed from the gas during the manufacturing process; and secondly, the power of the gas to take up and transport so much of the naphtha as to acquire considerable greater illuminating value when the naphtha is presented to it alone, without the presence of any other substance which acts antagonistically to the gas, * * * * *

"I never yet saw common gas which could not take up, and carry during its distribution, four or more grains per foot of suitable hydrocarbon vapor. At present most manufacturers of gas take the best means with which we are acquainted for removing hydrocardon vapors from gas. They cool their gas and hydrocarbon vapors down to 60° or 70° Fahr. (and in some cases lower) as quickly as they can, and the form of the condenser which will do this most quickly and certainly, is the one generally preferred. No suspicion seems to cross their mind that they are enabling the tar (*i. e.* the heavier oils) to dissolve out from the gas and carry down with it the vapors of light hydrocarbons which they ought to retain in their gas with the utmost sedulity. * * * * *

"The hydraulic main ought to be kept at a proper temperature, and to be prolonged sufficiently to allow the less volatile bodies to condense and pass away to the tar well, and the more volatile to go forward with the gas; or what is much better, a special apparatus kept at a regulated temperature should be interposed between the hydraulic main (in this case kept hot, of course) and the purifying apparatus, in which the gas and lighter hydrocarbons might be separated from the heavier bodies, and so a large portion of hydrocarbon vapor might be distributed with the gas—in other words the gas might be made more illuminating. If thus separated there would be no difficulty in distributing all the light hydrocarbon vapor which the tar would give up, as may be proved by the well known process of pouring naphtha into the mains, which the gas picks up on its passage and carries to the consumers. Gas at common temperature can take up and carry a considerable quantity of the vapor of the lighter hydrocarbons, *if they be brought in contact with it after ha ving been separated from the heavier ones;* but the power of the heavy to carry down the light is greater than that of gas to carry them on. and hence all fall together in the present system of condensation, to the great detriment of the gas. The loss of light which gas suffers upon being passed through cold heavy oil, and the inability of the same oil when heated to act upon it, both illustrate this. I have passed gas through heavy oils, about 400° Fahr., and have found its illuminating power identical with its illuminating power before it passed through the oil. It gave nothing to them and it took nothing from them. I have also passed gas through the same kind of oil at ordinary temperatures, and have had its illuminating power reduced at less than one candle for a consumption of five feet an hour, whereas before passing the gas through the oil it had an illuminating power of 13 candles. The cold oil had dissolved out of the gas nearly all its illuminating matter. In the present method of condensation this is imitated in a great measure. All the oils, the water, and the gas are cooled together, and thus an opportunity is afforded to the heavy oils to dissolve out the light ones from the gas, whereas the heavy oil should have been condensed first, at such a temperature that they could not damage the gas, and then the gas and the lighter vapors should have been cooled to the temperature proper for purification.

"This method of condensation would probably tend to lessen the deposition of naphthaline in gas mains, which now causes so much trouble. It is well known that naphtha poured into mains obstructed by naphthaline will dissolve it, and that deposition cannot occur at ordinary temperatures in the presence of a considerable quantity of the vapor of the lighter hydrocarbons. It seems probable therefore, that the presence in gas of as much hydrocarbon vrpor as the suggested process would keep in it, would enable it to uphold its naphthaline in a state of vapor, by diminishing the tendency of the naphthaline to crystallize. If it will accomplish this, it will be a great boon to those engineers who use Newcastle coal and very high heats. I should expect it to contribute to this end in another way. The heavier compounds which form tar have a strong affinity for naphthaline at high temperatures, and as they condense are apt to carry down the naphthaline with them. I should expect therefore, that by the fractional condensation which I have suggested, so much naphthaline would be removed from the gas by the heavier compounds, which would separate in the 'hot condenser' that the vapors of the lighter oils would be able to uphold the remainder, and thus stoppage of mains would become a very rare thing. if not a thing unknown. It is impossible for me here to state at length the reasons for this expectation. It must suffice to say that a large and long experience leads me to it, and I shall be much surprised if it do not prove in some measure correct. —REV. W. R. BOWDITCH.

The zigzag scrubber has been designed in accordance with the preceding suggestions of the Rev. W. R. Bowditch, and the results obtained from the one erected at the New Haven Gas Works in 1874, have certainly verified most of his predictions.

As the Graham condenser was designed for the same purpose as the zig zag scrubber before mentioned, I will give a few extracts from the *Journal of Gas-Lighting*, which give a description of the apparatus, and also some of the results.

"This arrangement of condenser was first proposed by Mr. D. A. Graham, in the columns of the *Engineer* several years ago, and has since been adopted by several large companies. It consists simply of a large flat screw, along which all the tar and ammonia water made in the process of distillation, passes with the gas through the entire length of piping; the object being not only to cool the gas preparatory to scrubbing and purifying, but to naphthalize it with the naphtha present in the tar, and also to remove a considerable portion of the ammonia previous to scrubbing. The ammonia water which gravitates along with the tar and in contact with the gas, leaves the condenser of a strength equal to 5° Twaddle, a result which is considered highly satisfactory. The application of this condenser has very perceptibly increased the illuminating power of the gas from the same class of coal; and the scrubbers and purifiers have been found to do their work much more efficiently.—Vol. 22, page 765 *Journal of Gas. Lighting.*

"The objects obtained by this kind of condenser are that the gas is gradually cooled, and the tar held in contact with the gas for a considerable time, and so removing a portion of the sulphur compounds, and, according to Mr. Graham, the average strength of the liquor produced therefrom is about 6½ per cent Twaddle (13 oz.), and from his experiments, he calculated that he removes by his apparatus about 16 pounds of carbonic acid for every ton of coal carbonized. * * * * * * * *

"At the ordinary temperature of the atmosphere, tar has a strong affinity for bisulphide of carbon and other compounds; hence it is desirable to employ it for the purpose of removing these impurities. For this object the gas should be kept in contact with the tar as long as possible, by having the condensing pipes of considerable length, and employing means to keep them at a moderate temperature, for if this be too high, the purifying power of the tar is diminished, and if too low, the hydrocarbons are deposed and absorbed by the tar.—*Journal of Gas-igLhting*, vol. 24, page 431.

Though the Graham condenser is similar to the system of placing the gas mains round the walls of the retort house, we see from the preceding extracts that it is a ualnable arrangement for removing impurities from the gas, and improving its illuminating power by taking up the lighter hydrocarbon vapors; therefore it will save enrichers, lime, labor, and deposits of naphthaline in the mains and services.

As the zig-zag and drip system makes a much more compact apparatus than Mr. Graham's, and also lets the gas pass through it, at a much higher temperature, I think it will produce better results.

High heats *do not* really produce more naphthaline in the retorts than low heats, though it is generally supposed that they do; but the high heats produce much less tar than the low heats, consequently the high heats do not produce enough tar to purify the gas by the ordinary method, and therefore we are troubled with the naphthaline in mains, etc.

To get over this difficulty we must adopt an apparatus that will keep and utilize all the hot tar that we do get, and not let it cool immediately and escape to the tar well. WILLIAM FARMER.

Mr. Sherman—I will state that the scrubber was put in at New Haven in the autumn of 1874. Gas was turned into it in October. At that time they were having over fifty complaints a day, on account of naphthaline, and in two weeks all complaints from that source had ceased. We have had no trouble at our works, or at our holders, or in our street mains since. During 1875 we had very few complaints from our consumers on account of naphthaline. We have had more this year than we had last. We have had, during the present month, about three a day; but this, considering that we have 6,000 consumers, I submit is a very small number of complaints.

A member—What kind of coal have you been using? Have you made any change at all in the coal which you used previously to the use of this apparatus?

Mr. Sherman—No, sir; we use the same coal. Naphthaline seldom comes from using very rich coal. Companies using the richest coals have the least trouble with naphthaline. With the coal that we are using now, in connection with this apparatus, we have very little trouble from naphthaline. The richer the coal that is used the less trouble there is with naphthaline.

Mr. Neal—The Boston Gas-Light Company have been in the habit of using Albert coal, and making very rich gas. They never had been troubled with naphthaline. Last summer they discontinued the use of Albert coal. They told me that while they used the Albert coal they did not know what naphthaline was, but after they ceased using it they found out exactly what it was. They commenced using Albert coal again, and the naphthaline all passed away. I have been troubled in the works under my charge very greatly with naphthaline. I was troubled some years ago, when I used Nova Scotia coal and Pictou coal. Afterwards I used Westmoreland, Penn, and Youghiogheny coals, and I shall be very glad to find a remedy. I find that the disease comes on about the time that the warm weather begins, and then about the time frost comes it disappears. It comes and goes like the yellow fever. That is the way it operates in works under my charge. I don't know how it is with others, but it has been, in my experience, a very troublesome thing to deal with. So far as the company is concerned, of course, we can employ men to

remove it, but the chief cause of annoyance is to our customers. Sometimes our customers come to us and say—"something is the matter with the gas," and ask what it is. They say, it began about two weeks ago, and they have let it go on thinking that it would go off. I say that it never will; but, as soon as anything is the matter with the gas, to send word to the office, because it never will pass off. We try to do all we can to please our customers because, now that we have this rival kerosene oil—although it is not so much of a rival as it has been—we try to do all we can to make our customers satisfied. We don't like to have any thing the matter with the gas which will cause our customers to be dissatisfied. We don't like these things to happen. We want every body to use gas instead of kerosene oil. I was very much pleased with the remarks that were made in this paper. I was pleased to see and hear the explanation of this apparatus; but when we were told that there were some complaints, even when that was used, in regard to naphthaline, I did not think so much of it. What right has the gentleman who used the apparatus to have a single case of naphthaline? I would like to ask Mr. Sherman if he made any change in the quality of coal that he has used since 1274.

Mr. Sherman—When I took charge of the work we used about 30 per cent. of cannel coal. During the last year we have not averaged over eight per cent. There was no naphthaline, during 1875, to make any account of. During the last four years we have been running very high heats, and have had very large yields, which is supposed to produce naphthaline.

Mr. Neal—The gentleman gives a new reason for the accumulation of naphthaline. High heats do not produce naphthaline; but if you run high heats you do not produce coal tar enough to take care of your naphthaline. This is something entirely new to me. f that be the case, perhaps it would be as well to make a great deal of tar and very little gas and unite it—something like taking blood from one man's arm and inserting it in another's.

The Secretary—I would like to ask whether this scrubber affects the candle power of the gas?

Mr. Sherman—I don't know what they were making before that was put in. I know what it has been since.

The Secretary—I wanted to get at the quality of the gas in candle power.

Mr. Sherman—As I said, I know what they are making now. I don't know what they were making before.

The Secretary—I want to know what it has been since that was put in.

Mr. Sherman—We make a 16-candle gas. That is what we try to keep it up to; that is our standard.

Mr. Neal—Where did the greatest trouble arise before the apparatus was put in? About the inlet to the holder or the outlet?

Mr. Sherman—All I can say in regard to the apparatus and the effect it has produced since it was put in is, that we had over fifty complaints a day previous to putting this up in October, 1874. The works were completely choked up with it, and the inlet and the outlet to the holders were filled with it, but of course the company could clear that away. The complaints came principally from the consumers. We had been greatly troubled at the works, but have not been since the apparatus was put in.

Mr. Neal—I have had a great deal of trouble both with the inlet pipe and the outlet. Of course the inlet pipe could be taken care of, but the outlet pipe was for distribution, and it was found choked up with it to a most annoying extent. But now it has left the works and gone down the street. We don't have any trouble at the works now, but the trouble is with the consumers.

Mr. Reid—I would like to ask Mr. Sherman how many gallons of tar he gets.

Mr. Sherman—I don't know. I never have measured it. I know how much we have sold.

A member—What was the consumers trouble? How did you get clear of it?

Mr. Sherman—I would go around myself and investigate the matter, and my usual mode of proceeding was merely to rap the service pipes. I found that by merely striking the pipe it would free it generally.

A member—You found it in the service pipe.

Mr. Sherman—In every case.

A member—We have been troubled with it a great many times and I have always found it in the rising main. I have attributed it to rust in the pipe. I did not know whether it was naphthaline or rust in the pipes; We have used the force-pump and have blown it out.

Mr. Sherman—I have always used naphtha myself. I never had any occasion to use the pump.

Mr. Littlehales—I think there is a little misapprehension about high heats and low heats. It seems to me that high heats convert a great deal of the hydrocarbon vapors, consequently there is not so much vapor to absorb the naphthaline as there would be when the gas was made at a low heat. I think that is an explanation of the matter.

Mr. Cathels—We have had a good deal of difficulty from this source, and I have adopted a plan by which f think, the trouble is, in a great measure remedied. I don't know whether it is quite as efficient as Mr. Farmer's apparatus, for that would appear to be very efficient for the purpose. My plan is to keep the gas in contact with the tarry oils. If you convert too large a quantity of the tarry oils, you leave too little tar in the gas for purification. At all events, I think the plan is sufficiently simple and practical. It is simply to run a pipe, taking care that the pipe is not too large, along the retort house wall, so as to bring the gas in contact with the tarry vapors. But whatever form is adopted for this purpose, the principle seems to be to prolong the hydraulic main, or to interpose a sufficient length of pipe, so as to keep the gas in contact with the tarry vapors as long as possible. If that principle is adhered to, I am sure those who are troubled with naphthaline, will find the difficulty greatly obviated. I do not suppose that it will do away with it entirely, but it will reduce it to a mere minimum, and will bring it down to two or three complaints a day instead of perhaps 100 or 120.

Mr. Neal—You run the pipe across where?

Mr. Cathels—We run the pipe across the retort house wall.

Mr. Neal—Which way do you pitch it into the condenser?

Mr. Cathels—Yes, into the condensers with just a slight fall.

Mr. Sherman—I was very much pleased with the Graham Coil Condenser last year which was put in at Worcester, and as the engineer is here to-day, I would like to ask him how it works.

Mr. Rollins—So far as the condenser is concerned it is very good, but as a preventive of naphthaline I don't think it is worth a cent.

Mr. Sherman—It seemed to be a very good thing, but it had not been set in operation before I left Worcester.

The Secretary—I think I have a right to say something in regard to the condenser. I used some four or five, and I will say this much for them, that while using them I had no trouble with any deposit in the bottom of my condenser, or my purifiers; but, as for taking out naphthaline, I don't believe they are worth a penny.

Mr. Price—Will the gentleman explain to the Association the size of the condenser, and where it is located?

Mr. Rollins—It is located immediately on the end of the benches.

Mr. Neal—I think this subject is pretty nearly exhausted, and that we had better go to something else.

The Secretary then read a paper, by Mr. Starr, on the use of gas for culinary purposes, as follows:

To the American Gas-Light Association.

Gentlemen: Having had several invitations from our worthy secretary to present to you an account of my experience and success in introducing the use of gas for culinary purposes in my city, Richmond Ind., I felt I could not excuse myself from complying with his request, as I think it has been of great benefit to my company and to my consumers, for its convenience and comfort in cooking. The use of gas for cooking has not only retained, during the coal oil furor of the last two years, many of our consumers of gas for illumination, but caused many others to fit up their houses for gas burning.

In my city over 90 per cent. of the dwellings have gas stoves set, all using them more or less. Many during the warm weather do their entire cooking and ironing with them, others using them only in preparing their morning and evening meals, and some only in preparing tea, being tender on the subject of gas bills.

For ironing it is especially comfortable and convenient, enabling a person to do the work in much less time, and with greater comfort and pleasure.

In heating irons, care should be taken to frequently wipe the moisture off the iron until it is heated, which prevents the iron becoming rough. And in cooking wide bottom vessels are the most economical, as the heat has a greater effect on them.

In using them, for economy, I advise consumers not to cook or boil more than they want. It is not good management to boil a gallon of water, when they only want to use a quart. A great deal of the cheapness is due to the fact that the fire is as hot in a minute after it is lighted as it is in an hour, and when the cooking is done by turning off the gas, the expense ceases, which is not the case with coal or wood fires.

It was quite accidental my introducing it for cooking, as I had feared it would increase the gas bills so much that consumers would quit burning entirely. I noticed my servant girl was using upon a bracket a little tin gas stove, and a quart fruit can, for heating water for tea and other light purposes, when there was not any fire in the cook stove, and keeping the kitchen cool and pleasant for her to work in. As my forte, (if I have any) is to have things handy about the house, I had a convenient shelf made, and placed on it two No. 3 Dome stoves, and soon found that about all the cooking of my family was done on them. My people were so pleased with these stoves that I set an experimental meter to ascertain what it cost to cook with them. I found that with gas at $3.60 per M. it cost from 1½ to 2 cents to prepare breakfast for our family of four persons, and from 3 to 5 cents to prepare dinner; also from 1 to 2 cents for tea for us, altogether two to three dollars per month for cooking and ironing. Allow me to add, that these figures require care and do not include washing, housecleaning, etc., nor do they apply to very large expensive families where several courses are served, but they do apply to the thousands and tens of thousands who would love to have its comfort and convenience, if they only knew how cheaply it could be obtained

Having ascertained what it cost to cook with gas, it was necessary to find whether it was cheaper than wood; so I had a cord of dry wood weighed and found at the prices we then paid for it, with sawing and splitting the wood cost about $7.00 per cord, I found that five lbs. of wood cost one cent. We then weighed the wood for different meals and found it cost a considerable per cent. more than gas, besides the increased trouble and danger of a wood or coal fire. Many using these stoves say it is not half the trouble to cook with them, that it is to cook by a wood or coal fire.

Being armed with these facts, I adopted Mr. Gough's advice on the temperance question, "to agitate." And I did agitate and agitated, and advertized, and puffed by locals, and talked as I never talked before, that there was money in it. I brought it before the people untill nearly all have them, and all new consumers get them.

At first I would put them up to be used a month, and if not liked to remove them, free of cost I never had to take out but one set, and in that case the wife objected to her husband having them put up, and she only cooked one meal on them; she was determined not to use them, and she did not, thus verifying the old adage that to "convince a man against

his will he will be of the same opinion still," and I suppose it is the same with woman.

I have erected at my rooms a cabinet kitchen. I call it by that name for it looks like a cabinet or library when closed. In it we sometimes prepare a meal for a dozen persons, and then close it up and eat by it, and a stranger would think he was eating in a library instead of a kitchen.

It has a chamber in the upper part which is connected with the chimney, which takes away all the odor of cooking. We think it is a complete success for beauty, convenience, and comfort. I have endeavored to lay before you my experience and observations, believing it is the interest of gas companies to bring about a more general use of gas for every purpose to which it can be economically applied, thereby increasing the demand, and consequently enabling them to reduce the price to the consumers, and inducing them to use it in lieu of other more disagreeable and expensive articles.

James M. Starr; Pres't Gas Co.,
Richmond, Ind.

Mr. Neal—I would like to ask Mr. Starr some questions in regard to the stove he used—whether it was of any peculiar construction that it is free from smell. In the summer time gas is sometimes used in my house for cooking purposes, and it makes a very unpleasant odor. The great object, it seems to me, is to free the gas from that. Gas stoves are put up in bathrooms and sleeping rooms, but, I think, they are very unhealthy, as there is always a very unpleasant odor coming from them. Does the stove that you use have any odor to it?

Mr. Starr—I am not troubled with any unpleasant odor, and I attribute its absence to two causes. I use for purification a preparation of iron which I buy at cutlery works—grindstone dust. I put in about 15 inches as a layer of lime, and about 4 inches of the iron. Then, besides that, as I mentioned in the paper, I have a chamber on the top of my stove which connects with the flue, and the odor passes off up the chimney. I will state that we are not keeping house. We have a suite of rooms and take our meals at hotel, but when we have company we prefer to have our meals in our rooms, and they are cooked on this gas stove, and served on the cabinet, and they don't know it. They are certainly very convenient. There is a great deal of difference in people cooking with gas. Some people will use four times as much as others, and will not do any more cooking. There is one family, consisting of the husband and wife and three children. The wife does her ironing with it, and it has been a great success. She don't use it for light. Her gas bill for four months was only $5 70, and she did her cooking and ironing with it. We have cooked dinner on ours, have cooked meats, and prepared coffee, tea, etc., and have had no trouble at all. They are very popular in our town. In regard to the labor—you have no idea what a saving of labor there is. There are no ashes to take care of, and no blacking of the stove to do, and none of the disagreeable smell of grease flying over the stove. It takes about half the labor. The heat is very quick. The stove is just as hot after the gas has been lighted five minutes as it is after it has been lighted for an hour. It is better to have the vessels used in cooking with broad bottoms as the heat has a better effect. These stoves are being rapidly introduced. There is scarcely a house being built in our town where these stoves are not put in. I found out that it was a good thing, and agitated with the results I have mentioned.

Mr. Harbison—I would like to inquireof the gentleman whether, in making this comparison, he made an estimate based upon coke or coal. He tells us of the comparison that he made with dry wood; but, in many places, a large quantity of coke is used for cooking purposes, what will we do with our coke?

Mr. Starr—I would advise you to do as I do. I have the best arrangement in that respect, I think, in the world. Every bushel of my coke is ground. I sold, from my works, 46,000 bushels of coke ground in this way—what they call pressed coke—all nicely screened and crushed without the expense of a single dollar. It works splendidly. I have an apparatus right at my door, and the men, in shovelling the coke out of the way, crush it. The fine dust I screen and mix it with a little dust from Youghiogheny coal, and that keeps up all the steam I want. It works very nicely without scarcely any cost.

The Secretary—What proportion of your gas consumption is used in cooking?

Mr. Starr—I could not tell that. When I first commenced, the summer consumption was very light. Our summer consumption has now increased considerably. I wanted to see if I could not find a day use for the gas mains as well as a night use. I take a very great interest in this question, and I would like to see the subject thoroughly ventilated by the members of the Association to see what their views are upon the subject of introducing gas for cooking purposes.

Mr. Harbison—You said that the gas for cooking for four persons would be not over $3 a month, or $36 a year. With coke at 8 cents a bushel, that would be 45 bushels of coke, and I think that 45 bushels of coke would go further, with a family of four persons, than that amount of money expended in gas; and they will get additional heat for the house in the winter season, which would not be had with a gas stove running one hour at a time for the preparation of a meal. We cannot all of us grind up our coke as Mr. Starr says he does his, and the question arises whether the increase in the consumption of gas will reimburse us for the loss on coke, for if people use gas for cooking we will have no market for our coke. Pretty much all our coke is used for domestic purposes We get eight cents a bushel for it. We find a demand for al the coke we produce, and, during, the past year, we have been obliged to send to New Haven for two or three thousand bushels to keep our customers supplied. We think we make a superior article of coke.

Mr. Starr—We have some very close calculators with us. They measure their coal and weigh their coke, and they consider that coke costs one-half or what hard coal does.

Mr. W. H. White—Does that refer to anthracite?

Mr. Starr—Yes.

Mr. W. H. White—We have always found that when anthracite coal gets cheap our coke immediately piles up, and we present it to the neighboring churches to distribute among the poor.

Mr. Cornell—I would like to inquire of the gentleman what kind of gas stove he used?

Mr. Starr—It is a stove manufactured by Mr. Sharp here in New York.

Mr. Cornell—Do you think that is the best stove?

Mr. Starr—I don't think it is really as good a stove as the stove I used first, which was made by a Dr. Musgrave, of Cincinnati; but the trouble with that stove was that there was a wire screen on the top, and anything falling over it immediately stopped it up, but in the Sharp stove there is a perforated tin protector, so that nothing gets on it, and we have no trouble at all. I do not recollect where Mr. Sharp's place is, but I think it is somewhere on Sixth Avenue.

Mr. Neal—This matter of using gas for cooking, and thus providing a use for our mains by day, as well as by night, is all very well. We are looking out for the gas interest, and if we can get the water companies to use our mains it will be of great benefit to us. I suggested to a water company of Charlestown that they might use our mains by day and pay us a reasonable rent for the privilege. (Laughter).

[To be continued.]

Suez Canal.—The filling up of the Suez Canal i an event that may now be considered indefinitely postponed. Last year between the two seas, only 52,700 cubic meters of "stuff" were removed, and the canal was navigated with facility by steamers drawing as much as 27 ft., and over 400 ft. in length. The bed of salt which forms the bottom of the Bitter Lakes, is gradually dissolving, so that this portion of the canal is being gradually but steadily improved, and with the increase of vegetation along the banks of the canal, there is a prospect of the production, in a not distant future, of a fertile and populous tract of country out of a sandy waste.—*Jour. Franklin Institute.*

The Manufacture of Coal Illuminating Gas.*

By Alfred P. Trautwein, M. E.

Continued from page 179.

We cannot very well dismiss the subject of charging and drawing the retorts without devoting a few words to the attempts which were recently made in the direction of performing these operations with the aid of machinery. The advantages which may be derived from the introduction of such a system are, in the first place, a very large reduction in the number of men employed is about the retort-house and secondly the great rapidity with which these operations can be performed; at the same time the wear and tear of the retorts is considerably reduced while the simple fact, that the arduous and exhaustive work of drawing the coke by the men is done away with, should alone be sufficient to commend the introduction of this kind of machinery; finally, it is claimed, that the coal can be distributed with greater uniformity than is the case in the ordinary method. The only really serious objection which might be urged against the use of machinery in these operations is its great first cost and the maintenance of the repairs which preclude its general application.

The attempts have been particularly numerous and successful in Great Britan, where the subject of mechanical stoking has received a vast amount of attention, the first attempts dating back some 10 or 15 years. Of these the best known, perhaps, is the Best and Holden machine, which at one time was in very successful use at the Chartered Gas Works, Westminster; its operation required the services of four men, viz: one engine driver, one man for the "rake" machine and two men for filling and attending the scoops; it was there claimed that one pair with their eight attendants could replace 80 men working on the ordinary system. The scoops, it should be remarked, are emptied by being turned over automatically and then withdrawn, leaving the coal in very nearly the same manner as in the usual method, where it is deposited in a series of irregular ridges. Another machine, that of Dunbar and Nicholson, it is believed, was introduced several years ago in the Dublin Gas Works giving entire satisfaction according to recent report. Among others, finally, the Foulis machine deserves attention for its simplicity, being worked by hydraulic power. It has, however, the same objectionable way of emptying the scoops that has already been pointed out in the case of the Best and Holden machine. The coal is supplied to the machine in boxes, each holding the charge for one retort; the boxes are raised by means of a small crane and the coal falls through the hinged bottom. The machine is said to require the services of only two men, one for the charging and another for the drawing machine.

On the continent the subject of mechanical stoking has never received any attention; in the United States, it was first taken up by Alonzo F. Havens, Esq., whose machine was in use for some time at the works of the Brooklyn Gas-Light Company. About four years ago Thomas F. Rowland Esq., of Greenpoint L. I. brought forward a machine which differs completely from any of those previously mentioned. It is the most interesting of all, since much more is here attempted than simply drawing and charging the retorts. The coal is measured out by means of the "coal meter," which is located immediately above the scoop.

The machine itself is so ingenuous as to warrant more than a simple passing notice. It consists, in the form in which it will presently be introduced in one of the works in New York City, of a strong and rigid wrought iron frame, which travels parallel to the benches upon a railroad elevated about 8 feet above the floor. To this frame is attached, in the first place, a small two-cylinder engine, provided with reversing gear; this furnishes the power for driving the entire mechanism, at the same time making the machine

* A Graduating Thesis at the Stevens Institute of Technology.

self-propelling. There is but one charging scoop which, however, can readily be adjusted to charge any desired retort; it is attached to a carriage which runs in guides on the main frame. The coal is deposited in an excellent way since the scoop, instead of having to be turned over, is arranged in such a manner that its bottom is withdrawn before the scoop proper itself; this together with the precaution that a number of transverse hinged partitions are provided, ensures the deposit of the coal in a very uniform layer. The "rake" is moved in a precisely identical manner and in addition is capable of adjustment in all directions, thus enabling the attendant to remove the coke with great thoroughness and dispatch. The coal is measured with great accuracy by means of the "meter", which also breaks it up into pieces of the proper size. The boiler is carried on a separate car and the entire machine, therefore, requires the attenndance of four men. The machine in its present form is characterized by its great compactness, neatness and strength and will certainly supply a long-felt want in our large gas works. In order to make his system a still more labor-saving one, Mr. Rowland arranges the coal supply for the machine in the following manner. The coal is stored at one end of the works where it is raised by an ordinary bucket and belt elevator and deposited in a stationary coal pocket. The machine is supplied from this pocket by means of a number of "pendant buckets" which travel to the other end of the retort-house and back on an endless railway; the buckets are moved by means of an endless belt, driven by a large drum at the coal end which, at the same time, also serves to distribute the coal into the several buckets. When the machine requires to be fed with coal, the bottom of the bucket which happens to be above it at the time is "tripped" and the coal is deposited in a "pocket" which is attached to the "meter."

The advantages of such a system in the retort-house are evident, since by it the amount of manual labor is reduced to a minimum. It is also evident that it is not applicable to many works as now built and to the smaller gas works; it would be a matter of great difficulty to decide where this limit actually is, since the system has not been tried in a sufficient range. It is stated, however, that charging and drawing the retorts by machinery must certainly be resorted to in the case of all works having a daily production of one million cubic feet and over.

FUEL FOR CARBONIZING.

The gas manager usually has but two kinds of fuel at his disposal for use under his retorts, viz.: the coke and the tar resulting from the destructive distillation of coal. Coal itself is rarely, if ever, used as carbonizing fuel and, indeed, it would for many reasons hardly be preferable to coke. In France, at one of the stations of the Paris Gas Light Company, attempts to heat the retorts by means of gas were made a few years ago and, it has been stated, with a high degree of success, the furnaces were there arranged according to Siemens' Regenerative System; it is evident, however, that this system, because of its expensiveness, is applicable only to the case of gas works of the very largest size.

Coke, on the other hand, is most admirably adapted to our purposes. Its complete combustion can be secured without the slightest difficulty; this probably is owing to two circumstances which are peculiar to coke. In the first place, it consists mainly of fixed carbon, and consequently it is an easy matter to supply just the required amount of air; coke differs in this respect particularly from bituminious coal, whose thorough combustion involves the fulfillment of numerous chemical combinations. Then, again, the porous nature of coke permits a more intimate contact with the air. Coke, finally, being a by-product of the gas works, is usually the cheapest fuel that might be employed for our purposes.

In estimating the revenue which arises for a gas works from the sale of its residual products, it is necessary to know how much of the coke and of the tar the process of carbonizing requires. In our particular case, however, where the quantity of coke for which there is a profitable market is but 55% of the total yield, while there is no sale for the tar, it would naturally be a matter of no great importance, but rather one of some interest, to know with exactly how much we might be able to carry on our operations successfully. The experience of the works in this vicinity seems to indicate that this consumption varies from 35% to 45% of the total yield of coke; this, it will be seen, corresponds to from 12 to 16 bushels per ton of coal carbonized. In 1875 the percentage of coke thus used at the four stations of the Philadelphia City Gas Works, averaged a fraction more than 38%. In a number of instances, with benches, it is true, somewhat larger than ours, the consumption was reduced to 33%, and in a few exceptional cases to a figure even lower than this. We will be on the safe side, however, if we assume that the quantity of coke thus used shall not generally exceed 33% of the total yield; this corresponds to a consumption of 12 bushels of coke per ton of coal carbonized.

Some saving, indeed, might be effected by using the red-hot coke as it is taken from the retorts; it is very doubtful, however, whether such a system, on account of the many inconveniences which are connected with it, would actually prove to be as advantageous as it would at first sight appear. A much more practical method of securing economy in the consumption of fuel is that which is resorted to in two settings which have come under our notice; in these the supply of the furnace is heated by the waste gases by means of a number of properly constructed flues. In this connection, too, an automatic damper closing device, as previously mentioned, would be found of more than ordinary value.

TAR AS FUEL.

In our case, we are in a position to use as fuel not simply the coke but also the tar produced at the works; and, indeed, even where there is a market for the tar it is in the majority of cases worth more to burn than to sell. It has been found that one gallon of tar is equivalent to from one-half to five-eights bushels of good coke. Our coal, as previously stated, yields us per ton about 12 gallons of tar which when used as fuel is equivalent to 6 bushels of coke; we will require 12 bushels of coke per ton of coal carbonized and will consequently be compelled to use, in addition to the tar, 6 bushels of coke or 16½% of the total yield. The tar may be burnt in the following manner: The stopper directly above the furnace door is removed and a piece of iron pipe or, what would be better still, a water tuyere, about 3" in diameter, is introduced in such a manner as to project into the furnace for a short distance, making, at the same time, an angle of from 30°—60° with the horizontal. The tar is kept in an iron tank, under cover, on the top of the benches, the heat from which serves to keep it quite liquid; a small pipe provided with a valve carries into the tuyere. A small jet of dry steam, which is superheated by being passed through a pipe which is exposed to the heated gases from the chimneys, is introduced into the furnace directly under the tuyere; the steam serves the purpose not only of subdividing the stream of tar but also of inducing a current of air through the tuyere, thus rendering combustion more complete. A further supply of air above the grate is secured by having a number of adjustable orifices in the furnace door. In this manner a fire is obtained which is even more intense than that of coke; it has been stated that a tar fire decreases somewhat the life of the bench, but at the same time higher and better yields may be attained.

We have now said all that is indispensably necessary on the subject of the bench, and the operations which are connected with it. We must add in this connection, however, that the gas, on leaving the retorts, passes upwards through the vertical ascension or stand-pipes, each mouthpiece having one, thence through the bridge-pipes and down the vertical dip-pipes into the hydraulic main. Great trouble is frequently caused by the occurrence of obstinate stoppages at different points in this system of pipes; they are caused by the accumulation of pitch which owes its existence to the high temperature of the pipes in question. This temperature is due both to the conductivity of the pipes and to the radiation from the bench; a partial remedy, therefore, was found in intercepting this radiation of heat by a heavy face wall, in enlarging the internal diameter of the ascension-pipe to 6" or even 7", in reducing its thickness as far as can be done with safety and, finally, in making it as long as practicable. In one instance it was suggested to surround the stand pipe with a "water-jacket," but we are unable to state with what degree of success.

We will now examine the

HYDRAULIC MAIN.

This is essentially a long iron main, usually supported on the top of and running the full length of the benches; when first put into use it is filled with water to a depth of a few inches, but this is soon displaced by tar and other products of condensation at this stage in the process. The several dip-pipes from the retorts dip into this liquid to a depth varying from ¼" to 2" in the several works. The gas is drawn off by means of a large main from the hydraulic main, while the "tar overflow," conveys the surplus tar into the tar well.

The chief duty which the hydraulic main is intended to perform is the prevention of an escape of gas backwards through the stand-pipes when the retort lids are removed; where an exhauster is employed and a vacuum is maintained in the hydraulic main this duty becomes of a somewhat different nature, and the "seal," as the amount of dip is called, is carried solely for the purpose of keeping out the atmospheric air when the retorts are "off." The hydraulic main at the same time serves, to some extent, the purpose of a condenser for the grosser impurities in the crude gas.

But although the action of the hydraulic main, even when in perfect order, is so beautifully simple, yet it is liable to get out order very easily. Owing to the settling of the brickwork, when some of the benches are not in use, the amount of seal on some of the retorts, for instance, might be diminished or even entirely destroyed, while the seal on the remaining retorts is correspondingly increased. For this reason it is customary to place the hydraulic main upon a number of adjustable saddles, instead of resting it directly upon the brickwork. At the Nassau Gas-Works, Brooklyn, E. D., the hydraulic main is supported in a far better manner; it there rests upon a bracket which is rigidly attached to a buckstave which is bolted to a solid stone pier, thus rendering the main entirely independent of the brickwork of the bench proper.

In the ordinary form of hydraulic main a large percentage, evidently, of the cubic contents of that part which is above the tar line is occupied by the dip-pipes, thus obstructing the free passage of the gas. This, though no great disadvantage, is remedied in two forms of hydraulic main which have come under our notice: the Stanley main, in use at the Nassau and the Farmer main, in use at the Laclede, Cincinnati and Pittsburg Gas Works. In both of these mains a second, though smaller main is cast with or attached to the hydraulic main, the former contains the dip-pipes, leaving the latter entirely to the gas; in this form, however, the hydraulic main is evidently more cumbrous and more expensive.

The hydraulic main for the projected works has the ordinary U section; it is of ½" boiler iron throughout and the top is attached to the sides by means of angle iron 3"×3". In this way the main is not as heavy as would be the case were it made of cast iron. It is 20" wide and 24" deep, the depth of tar being 8"; the several sections, equal in length to the extreme width of the benches, 8' 10", are riveted together by a butt-joint. The gas is drawn off at each end of the hydraulic main by means of a 12" main; they are provided with valves and any one of them is capable of taken off all the gas in case the other requires to be shut down. The tar overflow or syphon has an internal diameter of 6" and has a valve by means of which the amount of seal in the hydraulic main can be adjusted to a nicety. A number of hand holes for cleaning out the main are provided at convenient intervals.

[To be continued.]

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The Effect of Temperature on Iron Trusses.

The change of length in iron trusses caused by the change of temperature is allowed for, as is well known, by placing rollers under one end of each span. Such a contrivance cannot be used with arches, and they consequently rise and fall at the crown as the temperture varies. The amount of play to be allowed is easily obtained by multiplying together the coefficient of expansion of the metal, the length of the span, and the number of degrees from the greatest heat to the lowest cold. It is found, however, that the allowance previously calculated is more than is needed, and the question arises which one of the above factors is in error. It is stated that the structure lags behind the air in temperature; when a thermometer in the open air is rising, one protected from the air, and in contact with the iron, will have a lower reading, and *vice versa*. During a long continued elevation or depression of temperature, we should expect that the two thermometers would give indications more nearly alike. The lower chord of a bridge which is covered or floored over on the upper chord, will be protected from the extremes of heat and cold, and the change of length will then be small. The difference in the amount of expansion of the two chords would have the effect of changing the camber, or causing the truss to rise and fall without alteration in mean length. The often-observed fact that a bridge, even when at a considerable height above the surface of the water, will so protect the river beneath as to hinder and sometimes prevent the formation of ice in winter, shows plainly that the covering ameliorates the temperature which would otherwise exist below.

Some few types of trusses are not internally strained by a change of temperature; but in others a change of shape from this cause initiates tensions and compressions in the different pieces by which their lengths are modified. The resultant movement at one end may therefore be made of a variety of very small components which it would be difficult to trace out, but data from practical examples for given types of truss, would furnish a coefficient of expansion for use.

There is one other direction in which a reason might be sought for a less change of length in a bridge truss than is expected. The coefficient of expansion is not an absolutely fixed quantity, but increases with the temperature. In solids the increase between 32 deg. and 212 deg. Fah. is stated to be hardly appreciable, but for high temperatures the increase becomes a considerable quantity. This increase in the coefficients or expansion of bodies by rise in temperature is probably due to the distance between the particles being augumented with the heat, and their mutual cohesion being thus more readily overcome. The force exerted by an expanding or contracting solid may be measured by the power required to produce an equal change of length by compression or by tension. When a bar of iron of one inch in cross section has its temperature changed 12 deg. Fah., its expansion or contraction exerts a strain epual to about one ton—that is, it will require a force of one ton to keep the bar at the original length. If, then, the several pieces of a frame are under tensile or compressive stresses of some three or four tons on the square inch of section, and are thereby elongated or shortened—since the particles are separated to greater distances in the one case or forced more closely together in the other—will not the coefficient of expansion be less or greater than the one for the normal state of the metal under no stress, and correspond with that one which in the scale of temperature would be correct were the bar already heated or cooled to the same linear dimensions?

If this were a fact, we should expect than an iron arch would exhibit less sensibility to a given change of temperature with a heavy load than with a light one, or than the expected amount for a rib of the same span under no initial compression. The deflecting of the crown is easily measured. On the other hand the vertex of the curve of a suspension bridge cable ought to have a greater alteration of level for the same change of temperature.—*Iron.*

Action of Sodium on Benzol.

Some observers have stated* that when benzol is heated or digested with sodium it is decomposed or acted upon, but the nature of the product is not stated.

Why potassium or sodium should act upon a comparatively inert substance like benzol is not, from theoretic grounds, very evident.

To prove whether sodium has any action on C_6H_6 within a moderate range of temperature the following experiments have been made:—

Very pure benzol was prepared, by agitating the ordinary benzol with strong oil of vitrol for some days, washing with potassic hydrate, and distilling from water; it was then dried with calcit chloride, and rectified; after which it was further purified by several crystallisations, the crystals of benzol being pressed between (in a handscrew press) each operation, to separate any uncrystalisable hydrocarbon which might remain.

This benzol boils constantly at 80·5° to 81°, and its vapor density and percentage composition, by combustion, agree very closely with the calculated numbers: 8 to 10 c.c. of this benzol, along with 1 to 1·5 grm. clean cut sodium, was introduced into strong tubes (about 15 inches long), the benzol warmed so that its vapor expelled the air from the tubes, which were then sealed and heated in an oil-bath to 150° C. for four hours, at the end of which time a tube was examined, but the sodium showed no further signs of action than fusion into globules. The remaining tubes were then heated to 200° to 250° C. for 18 hours, when very little change was apparent, and the surfaces of the sodium having only a very slight brownish tint.

On opening the tubes under mercury, no—or only a very minute quantity of—gas was found to have been produced, the mercury almost entirely filling the remainder of the tube not occupied by the liquid benzol.

The benzol distilled entirely away between 80° to 81° without leaving any residue.

Potassium in the presence of finely-divided silver had no more effect than the sodium alone.

Zinc, or the copper-zinc couple, is also without action at temperatures up to 150° C.

It was found unsafe to continue the action of sodium at temperatures much higher than 230° C., several violent explosions taking place, probably owing to the action of the fused sodium on the glass.

II.

If clean pieces of sodium or potassium be warmed under benzol in which phosphorus is dissolved, or pieces of sodium and phosphorus heated gently together under benzol, the surface of the metal becomes covered with a brilliant red film of amorphous phosphorus, which adheres very closely and prevents further action.

The same action takes place in the cold, the film appearing at first yellow. It forms very rapidly on boiling, when the red substance on its first formation has the appearance of melting on the surface of the containing vessel.

No metalic phosphide is formed at temperatures under 100° C,, and the benzol is not affected.

W. R. H.

Chemical News.

House-Drains.

The following article is taken from the *Lancet*, of July 29th:

A deputation from the Society of Arts introduced a memorial on the subject of house drainage, on the 21st inst., to the notice of the Metropolitan Board of Worrks. The memorial pointed out that, although considerable powers have been conferred on local authorities with regard to the enforcing the proper construction and due maintenance of all house-drains, pipes, and connections, yet in practice such powers are not sufficiently carried out at the present time, and required to be amended and enlarged. The memorialists therefore urge that an amending Act of Parliament be passed as soon as possible, to secure that all house-drains connected with public sewers in the metropolis, and towns having an urban authority, should be placed under the inspection and control of local sanitary authorities. Sir Henry Cole pointed out that, with respect to houses built before the Metropolitan Management Act of 1855, it had been found that the powers conferred by that Act were inoperative, and that the vestries could not intervene. Sir Henry instanced the case of some houses in Kensington which were never free from typhod and scarlet fever. The question is a very important one, and we think that many houses of Marylebone, St. Pancras and other old London parishes would be very much astonished. if any inquiry were made into the condition of their house-drains, to find over what pestilential sewers they had been living. We believe there is no exaggeration in saying that the house-drainage of nearly two-thirds of the houses in the old London parishes is defective. The drains, originally constructed of brick, through age and the undermining activity of the rats, have become extensively pervious and the domestic sewage passes out freely into the basements, and but a small proportion reaches the sewers. There can be no doubt that such elongated cesspits ought at once to be swept away, and earthenware pipe-drains substituted. We would suggest, in addition to the proposal to submit the plans of house-drains and connections to the local authorities, that power should be given for the authorities to appoint an inspector to see that all such sanitary work was properly carried out. A case which came under our notice the other day shows the necessity of such an officer. A gentleman took a large house in a fashionable street, which was stated to be well drained, as the previous tenant had removed the old house-drains and laid down pipe-drains. Notwithstanding, a disagreeable smell was constantly experienced in the house. In vain were the water-closets ventilated, and the stable drainage, which was suspected, isolated by the introduction of concrete walls; still the smell remained. At last a spot of suspicious dampness over one of the flags of the basement offices attracted attention, and it was then found that the workmen who had laid down the pipe-drainage had been content

simply to lay the pipes in juxtaposition without cementing them together; consequently the house-sewage was finding its way freely out under the basement offices. Had it been compulsory on the contractor to have had his work passed by an official surveyor before it was covered over, such a piece of "scamping' would have been detected, and much annoyance, expense, and probably ill-health, prevented.—*Journal Society of Arts.*

Sir Joseph Whitworth and His Tools.

On Thursday, last week, the freedom and livery of the Turner's Company were presented to Sir Joseph Whitworth, in recognition of his distinguished ability as an engineer, his great improvements in the design manufacture, and application of machine tools, his special inventions for producing and measuring exact mechanical results, and his munificent endowment for the improved education of working engineers. The ceremony was held in one of the committee-rooms at the Guildhall, Mr. Edward Caffin, the master of the guild, presided.

The duty of introducing the new member devolved upon Mr. C. Hutton Gregory, C.E., who, addressing the Court, alluded to the condition in which Sir Joseph Whitworth found the instruments of mechanical production, to the improvements he had initiated or helped to produce, and to the result of those improvements. Little more than a generation ago the working mechanic was almost unaided by machinery. Engineer's tools were the lathe, a simple screw-cutting machine, the file, and the chisel and hammer. The simplest elementary form of slide rest was almost the only machine tool. The planing machine was unknown. The results generally were of a rude and primitive kind, and if work was produced of a high character it could only be by the great skill of the workman. Sir Joseph Whitworth foresaw the great advantages which might be attained by improvement in the means of producing perfection and exactness of machinery. He was esteemed the best workman among many good ones; but with the usual aspiration of real greatness he desired to excel himself, and that desire led him to devote himself to the production of machine tools, machines which in the production of other machinery for the various wants of mankind should improve the character and cheapness of work, and enable its supply to meet any future demand. Others joined in the honorable pursuit, and their joint efforts had produced planing machines, drills, shaping machines, slotting machines, and a host of other machines, which among them would produce work of every required form with a certainty, a precision, and a cheapness formerly unknown. But to make such work perfect two elements were still required—exact uniformity of manufacture and a perfect means of testing this exactness. These had been attained by Sir Joseph, who had produced machines capable of measuring a millionth of an inch, and had invented a variety of instruments and machines of the uttermost value. The results of these improvements were patent to them all. The production of machinery had been improved during the last generation to an extent previously unknown. An exactness and uniformity of manufacture had been attained, which enabled them to supply in any number the component parts of a machine which should be perfectly interchangeable, while a high class of manufacture and the means of repair of complicated machines could be extended with growing civilization and the ordinary colonization of the world, results to which skilled labor with old appliances would have been perfectly inadequate.—*Iron.*

Gas Stocks.

Quotations by W. R. Scott & Co., Bankers,

24 Pine Street, New York City.

November 16, 1876.

☞ All communications will receive particular attention

Gas. Co.'s of N. Y. City.

	Capital.	Par.	Bid.	Asked.
Harlem	$1,850,000	50	104	110
Manhattan	4,000,000	50	240	242
Metropolitan	2,500,000	100	140	145
" Scrip	$1,000,000	...	102	—
" Bonds	500,000	1000	104	—
Mutual	5,000,000	100	108	110
" Bonds, gold.	900,000	1000	105	—
New York	4,000,000	100	137	142
Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	180	185
Citizens	1,200,000	20	93	95
" Scrip	320,000	1000	95	100
Peoples	1,000,000	10	45	50
" Bonds	$ 325,000	...	...	95
" Scrip	300,000	...	85	—
Metropolitan	1,000,000	100	70	75
Nassau	1,000,000	25	75	80
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	130	135
" Scrip		...	98	100
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	—	80
" Bonds	200,000	1000	--	90
Baltimore, Md	2,000,000	100	150	170
" Ctfs., gold	1,000,000		105	—
Bayonne, N. J		100		90
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	100	—
" " Ctfs.	53,000	—	--	—
" " Bds.	124,000	—	—	--
Derby of Conn	160,000	100	60	80
East Boston, Mass.		25	132	----
Fort Wayne, Ind		100	..	...
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	152	—
Hempstead, L	25,000	100	...	—
Jersey City	386,000	20	160	—
Jamaica, L. I	25,000	100	...	—
Jacksonville, Ill	120,000	50	82	...
Lewistown, Maine	400,000	100	50	85
Lima, Ohio	60,000	100	10	...
Bonds	30,000		90	
Paclede, St Louis Mo	1,200,000	100	100	110
Peoples, Jersey City		...	125	135
Leoples of Albany	650,000	100	—	20
" Bonds	350,000	1000	--	--
Peoples of Baltimore		25	99	100
" Bonds			106	—
Perth Amboy		25	—	95
Rochester, N. Y		100	50	60
Richmond Co., S. I.	300,000	...	97	160
Woonsocket, R. I	150,000	100	100	...
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	112½	
San Francisco Gas-Co., S. Fr'isco Cal.			99	100
St. Louis, Missouri	600,000	50	—	100
Stillwater, Minn	50,000	50	—	26
Suburban, W'steh'str	390,000	50	—	100
Saugerties, N. Y	15,000	100	110	115
Troy, Citizens	600,000	100	—	100
Central, Westchester	466,000	50		95

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ONE ROTARY GAS EXHAUSTER AND CONNECTIONS capacity (75,000) seventy-five thous d cubic feet per day. Also, Engine Belting, etc., comple to run the same. The above machinery was furnished by the Gould Manufacturing Company of Seneca Falls, N. Y. Cost $1050, and will be sold at a liberal discount. Address Connelly, Naylor & Co, Constructors of Gas Works, Loek Box 804 Pittsburgh, Pa. 417-3t

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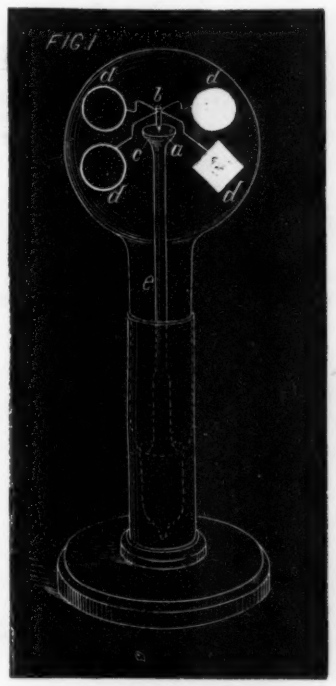
CROOK'S RADIOMETER.



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We are prepared to furnish Holders, Wrought Iron Roof Frames, Bench Castings, Condensers, Scrubbers, Purifiers, Drips, Bends, Tees, and all other Iron Work connected with Gas Works. Previous to 1868 our Mr. D. built *nine Gas Works* and *fifty-four Holders.* Since that date we have built *three Gas Works* and *forty-six Holders.* We *superintend in person* the erection of all our work, and would refer to the Gas Companies at the following places, where we have built Holders, since 1868:

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Pittston, Pa.
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Sharon, Pa.
Canton, Pa.
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Parkersburg, West Va.
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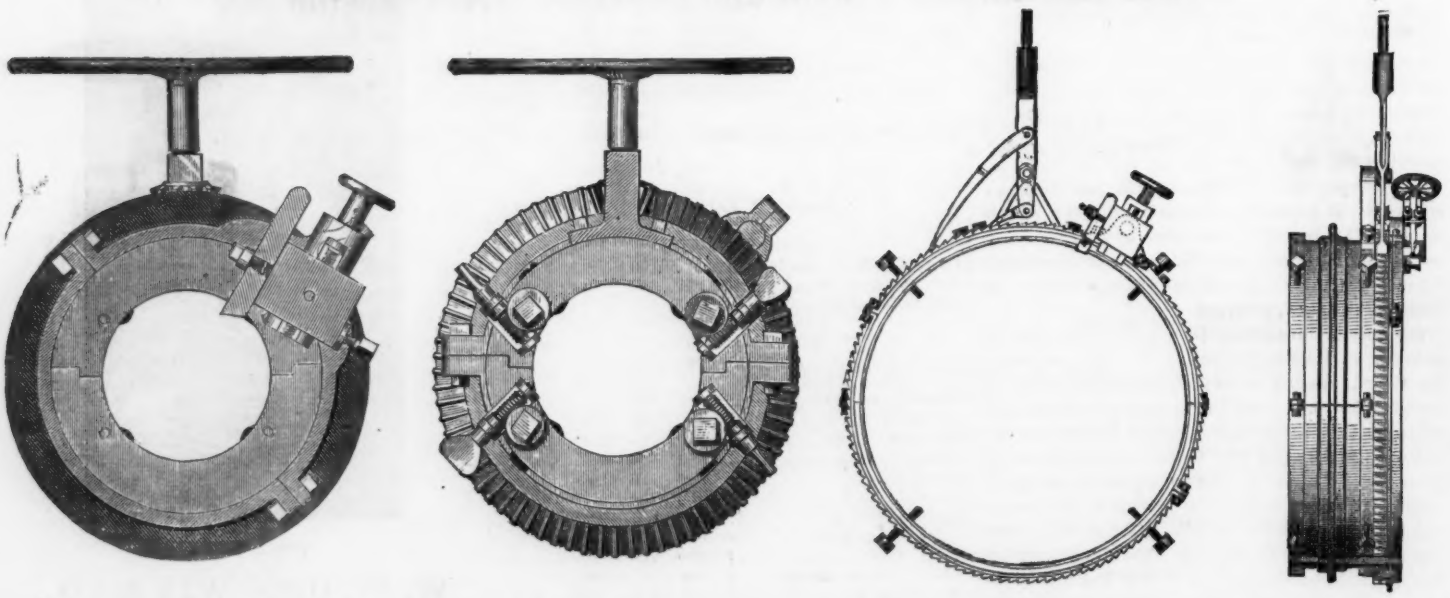
CAST IRON PIPE.



It will cut Cast or Wrought Iron Pipe, Shafts, or Columns of any size, making a clean, smooth, and square cut.

A Continuous Line of Pipe in a Trench or Building

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Our Machines for cutting 30-INCH PIPE have been furnished to the Manhattan and New York Gas-Light Companies, and operate to their entire satisfaction. The smaller sized Machines have been in practical use for nearly a year, with the most satisfactory results. For further information address

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The process can be put into either Coal or Oil Gas Works (or where both Coal and Oil are used) at small cost, without any interruption to the working of other benches. The Citizens Gas-Light Company of Brooklyn, after using it for more than seven months, have found it not only far better, but actually *cheaper* than atmospheric air in making Gas, with the use of "petroleum and its products."

Further information, and terms of sale of rights will be given, upon application to the Company 348-1y

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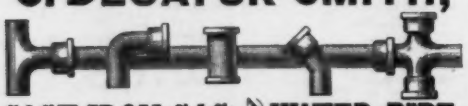

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Several Thousand 2, 3, 4, 6 and 8 Inch Cast Iron *Gas and Water Pipes* on hand, for immediate delivery.

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We claim these Gas Screens to be superior to anything heretofore used for the purpose of supporting heavy moist, or light layers of lime in the purifiers of gas works. These Screens are so constructed that they will not sag, *and must not be confounded with light split rattan Screens which have been discarded on this account.*

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WANTED—A SITUATION IN A GAS WORKS. THE undersigded (a young man) who has had seven years experience, connected with the operations of gas works wishes to engage himself as Superintendent of a works where the make is 5,000 to 50,000 per diem, or will accept a position in any department connected with operations of works. Address SUPERINTENDENT, care of M. COOMBS, Jr., Engineer Gas Co., Youngstown, Ohio 412-1m

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An examination of the merits of these inventions as demonstrated by practical experience in a large number of Gas Works employing them, will not fail to convince the intelligent Gas Manufacturer of the great advantages derived from their use.

Gas of unexceptional quality, of high illuminating power is made at many of these works by these processes, at a cost of from 40 per cent. to 60 per cent. less than an ordinary quality of illuminating gas can be made by any other methods in use. Gas Companies generally may easily, and at small outlay for making the necessary changes in manufacturing apparatus, double their net earnings, and supply a much better light to their patrons, at greatly reduced prices.

The Company respectfully refer to Companies using these processes in this city, Reading, Penn., Chicago and elsewhere, and especially to the Mutual Gas-Light Company of Detroit Mich., whose works more nearly conform in all details of construction to the original plans of the inventors than those of other Companies.

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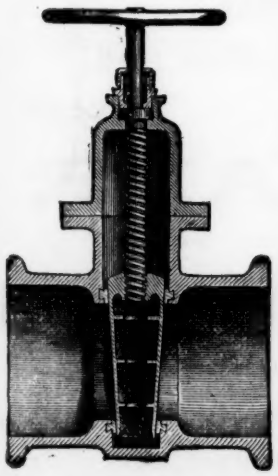

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They afford a direct passage the full size of the pipe. The seats are made of an alloy similar to BABBITT metal, specially prepared for the purpose, and superior to all other metals used for the seats of Gas Valves. It does not corrode under any circumstances to which it is exposed.

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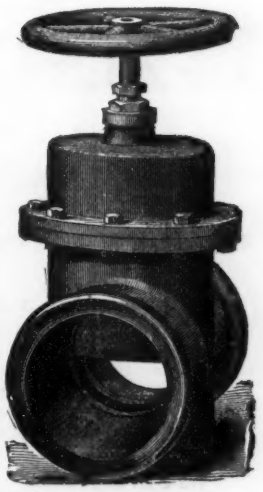

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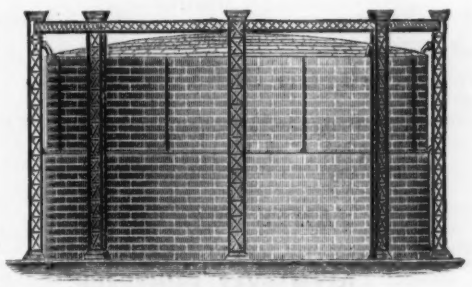

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Volatile Matter.	Coke.	Per cent. of Ash in Coal.	Per cent. of Ash in Coke.	Sulphur in Coke.	Sulphur in Oötl.	Sulphur in Volatile Matter.	Specif. Gravity. Coal.	Specif. Gravity. Gas.
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WITH ENGINE ATTACHED ON SAME BED PLATE.

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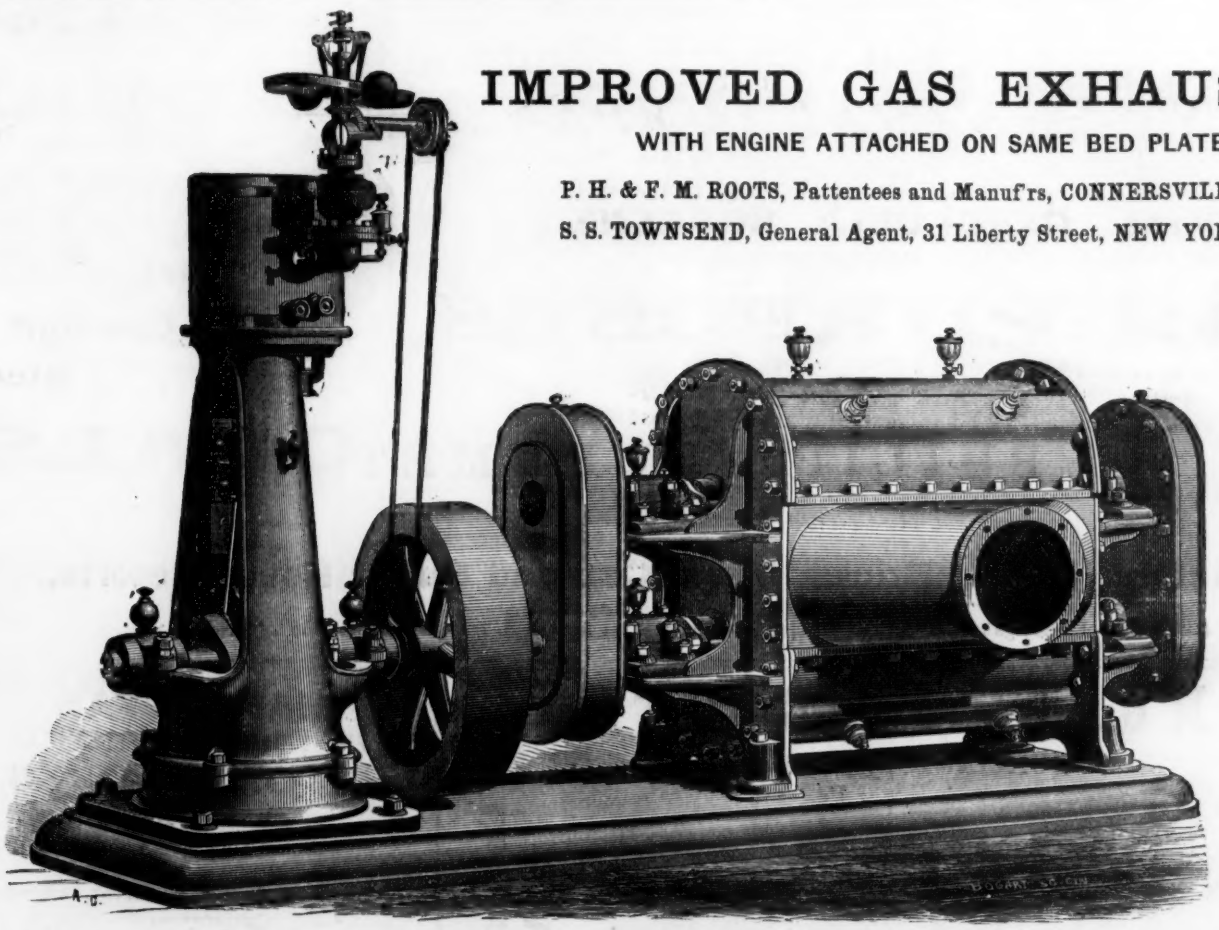

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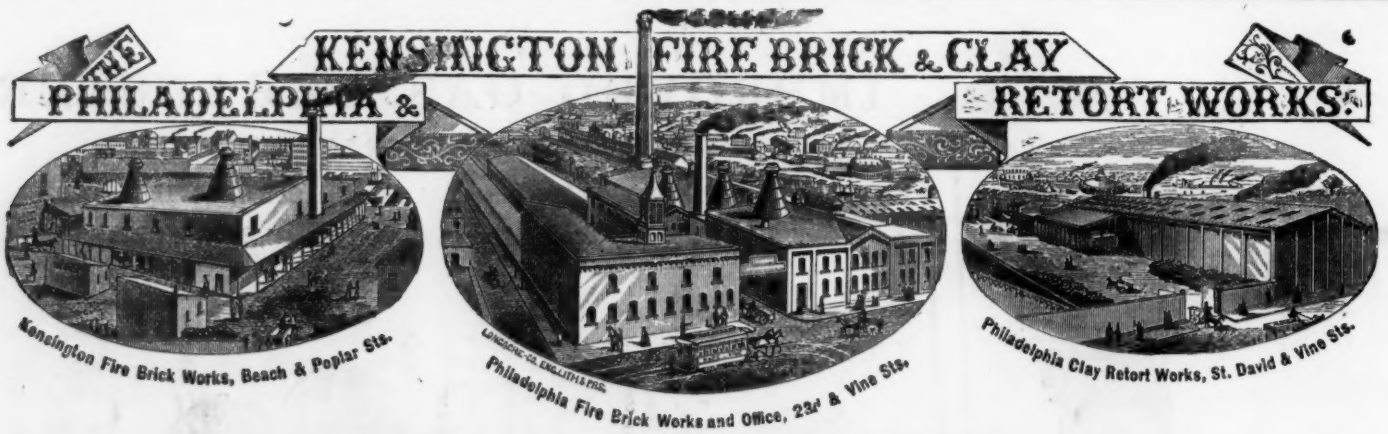
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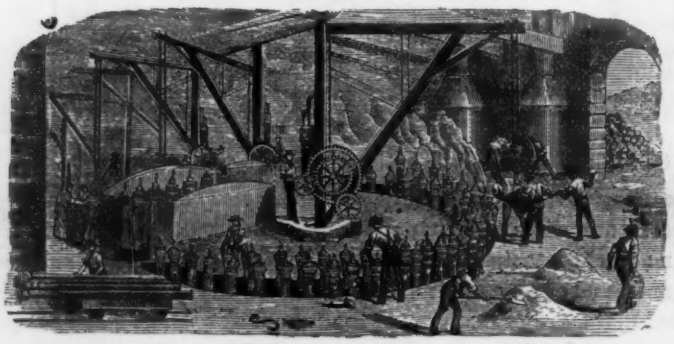

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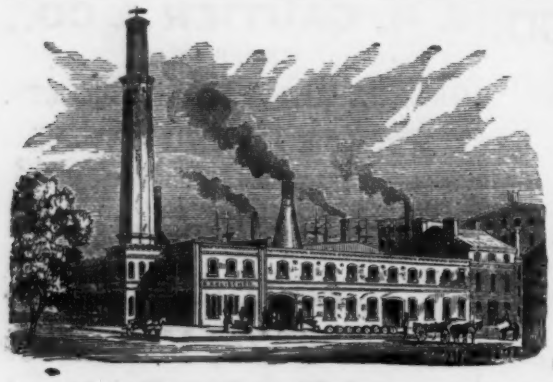

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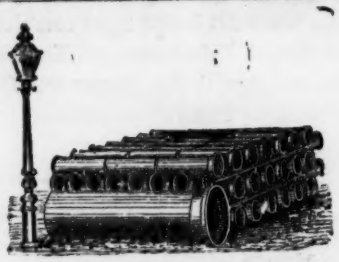

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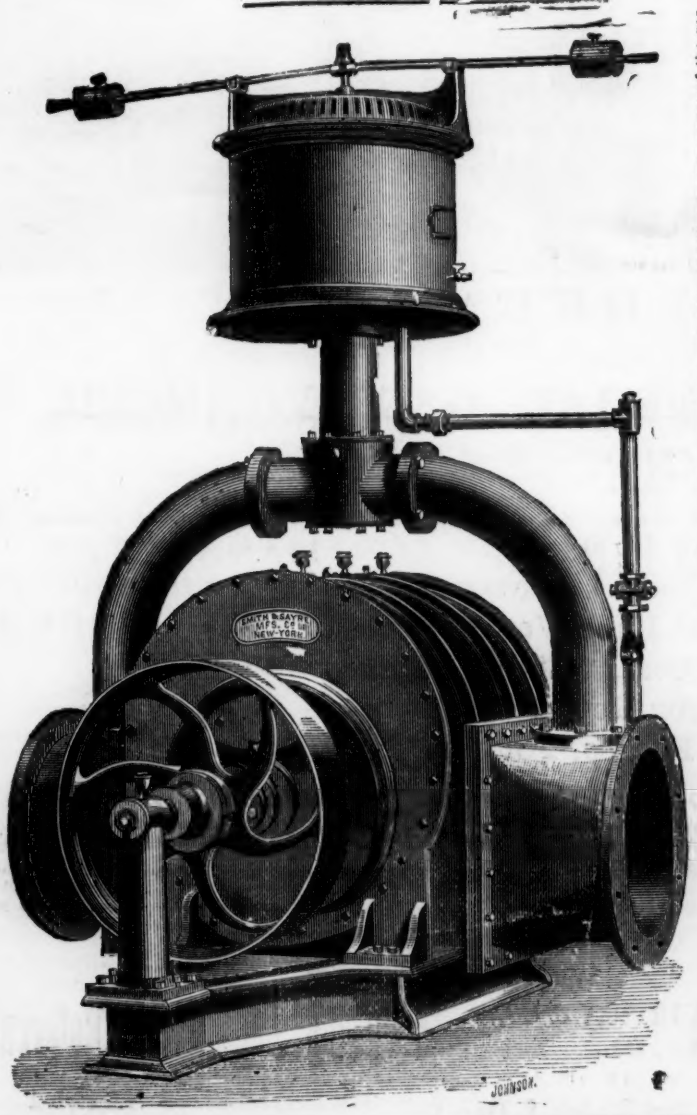

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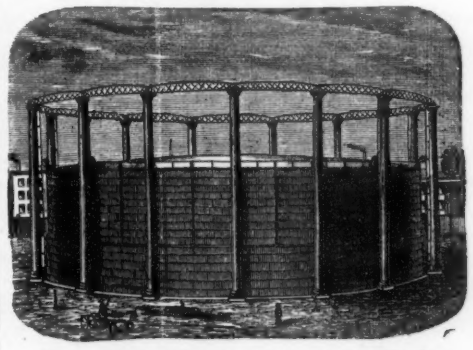

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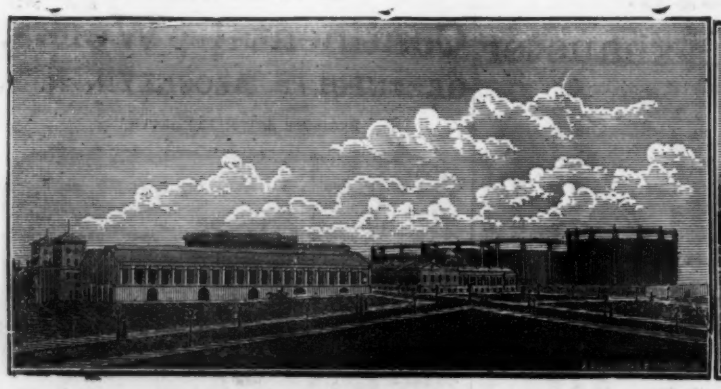

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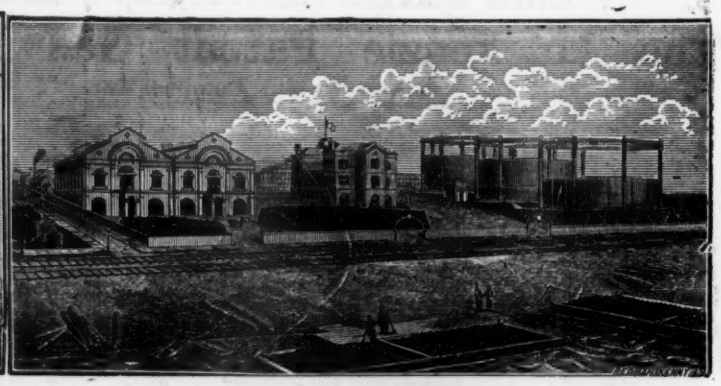

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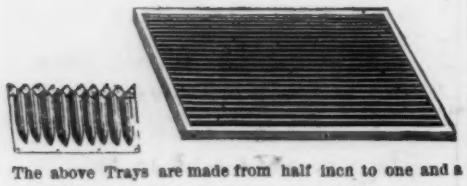

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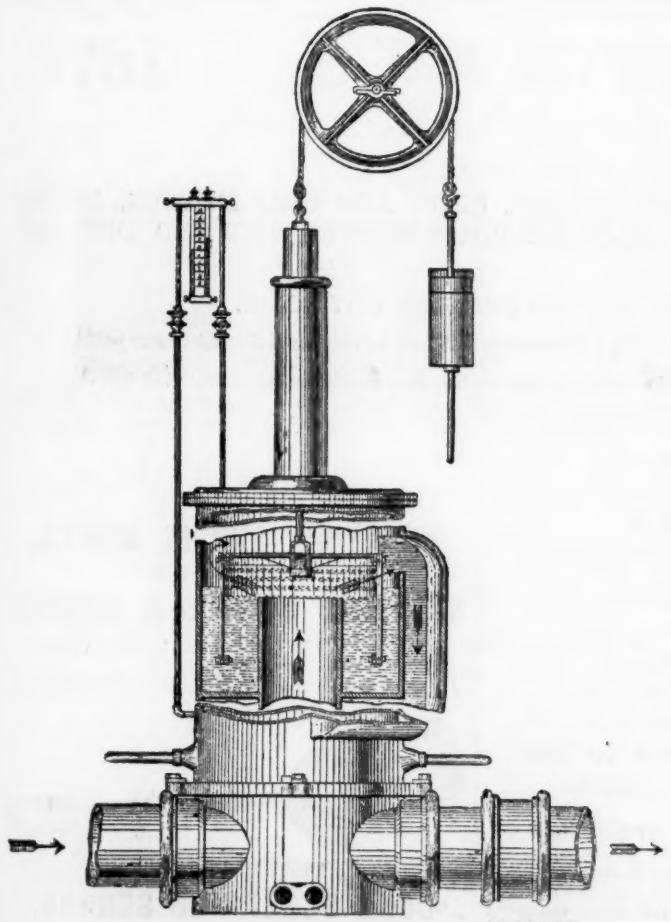

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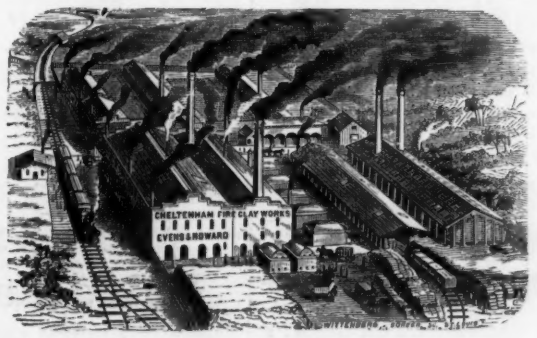

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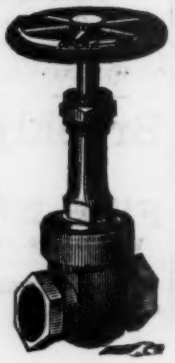

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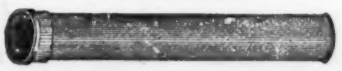

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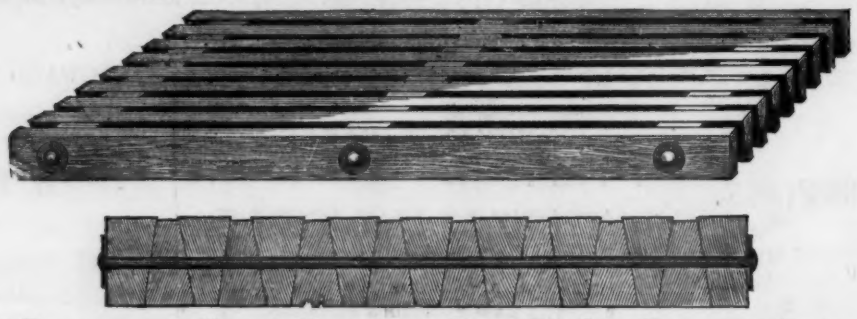

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